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Aspects of Honeybee Natural History According to the Solega

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Abstract: *Honeybees and their products are highly prized by many cultures around the world, and as a result, indigenous communities have come to possess rich and detailed knowledge of the biology of these important insects. In this paper, I present an in-depth investigation into some aspects of honeybee natural history, as related to me by the Solega people of southern India. The Solega recognize, name, and exploit four honeybee species, and are well aware of the geographical and temporal distributions of each one. In spite of not being beekeepers – as they only forage for wild honey – their knowledge of obscure and complex phenomena such as honeybee gender and reproduction, rivals that of comparable, non industrial beekeeping societies. Swarming, another hard-to-understand honeybee behavior, is also accurately explained by Solega consultants. I contrast this knowledge to that of European bee keeping cultures, as evidenced by the writings of Aristotle and 18th century European beekeepers. This paper shows that the Solega have a reliable and internally consistent body of honeybee knowledge based entirely on brief encounters with these wild, migratory insects that are present in the forest for only part of the year.*

Key Words: honeybee, Solega, Soliga, reproduction, swarming, Aristotle

Introduction

In a great many cultures around the world, honeybees and their products play important roles in several aspects of daily life, including food, religion, construction and medicine. Much has been written about indigenous peoples' traditional knowledge of this important group of insects, with studies focusing on issues such as identification and taxonomy (Posey 1983; Wyman and Bailey 1964), methods of obtaining, and the uses of, various honeybee products (Nonaka 1996; Posey 1978; Santos and Antonini 2008), and the representation of these insects in folklore and cosmology (Posey 2002). While the above publications frequently make reference to indigenous peoples' knowledge of the natural history of various honeybee species, as far as I can tell, there have been few in-depth studies of such knowledge, especially with regard to honeybee life cycles, reproduction and behavior. In this paper, I present some results of a language documentation project carried out with the Solega people of southern India. I focus more on consultants' knowledge of the fundamentals of honeybee natural history, than on producing an ethnographic account of honey-gathering practices.

Honeybees are plentiful in the Biligiri Rangaswamy Hills of Karnataka State in southern India, which are home to the Solega, a Dravidian-language-speaking tribal community. It is estimated that there are around 24,000 people who identify themselves as 'Soliga' or 'Sholaga' (Lewis et al. 2013). The Solega people who participated in the current study all lived in villages inhabited by no other ethnic group. The Solega readily exploit various honeybee species from March to July every year, when honeybees from the lowlands migrate into highland forest areas to take advantage of the seasonal flowering of large rainforest trees. It is also during this time that the Solega start to be keenly aware of the presence of bees in their environment, frequently looking up at trees for hives, and exchanging information on the movements of bee colonies in the neighboring forest.

Types of Honeybee

The Solega recognize and name four types of *je:nu* 'bees', namely *hejje:nu* ('giant honeybee' *Apis dorsata* Fabricius Hymenoptera: Apidae), *t(h)uḍuve je:nu* ('Asiatic honeybee' *Apis cerana* Fabricius Hymenoptera: Apidae), *kaḍḍi je:nu* ('dwarf honeybee' *Apis florea* Fabricius Hymenoptera: Apidae) and *nesari je:nu* ('stingless bee' *Trigona iridipennis* Smith Hymenoptera: Apidae) (Figure 1). Further, two kinds of Asiatic honeybee are recognized by the Solega: *kencu thuḍuve* (the 'red' variety) and *kari thuḍuve* (the 'black' variety). The implications of the ethnotaxonomy of honeybees are beyond the scope of the current paper, and will be addressed in a forthcoming publication. While there have been no taxonomic surveys of the insect life of the region, it is probably correct to say that there are no other species of social, honey producing bee in the Solega's forests. There are, however, a number of wasps (social and solitary) and bees (solitary) that the Solega do not label as *je:nu*. The term *je:nu*, as applied to the insect (the word can also mean 'honey' or 'hive'), therefore differs markedly from the western biological concept 'bee,' being used by the Solega to refer to only those bee species from which honey is harvested. The following information has been collated from around 15 interviews or informal conversations with a total of six male Solega consultants from five different villages. The ages of the Solega men ranged from 33 to >70. Information was collected over the course of four field trips, between 2008 and 2012, either during planned elicitation sessions at the speaker's village or at the author's field station, or opportunistically during forest walks on which bees were encountered. On two occasions, consultants stopped to harvest honey from hives of *A. cerana* and *A. florea*. The author spoke a mixture of Kannada and Solega during these sessions, and the Solega men were asked to reply only in Solega.

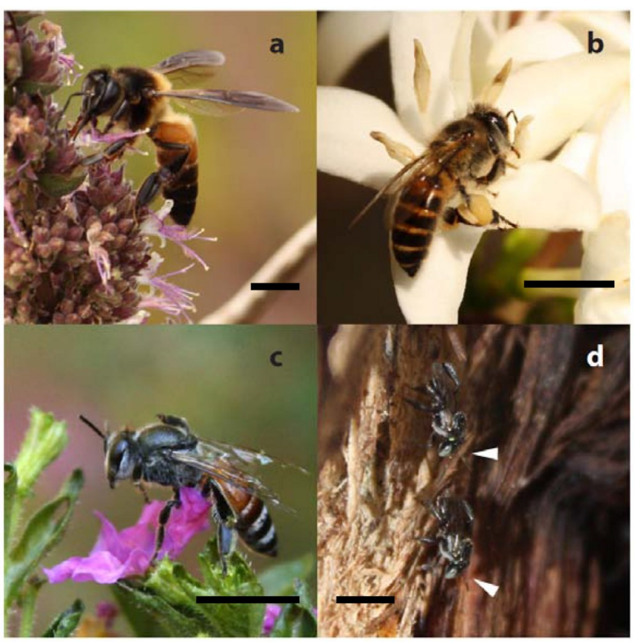

Figure 1. The four honeybee species named by the Solega: (a) *A. dorsata*, (b) *A. cerana*, (c) *A. florea* and (d) *T. iridipennis*. Scale bars are 5mm long. White arrowheads indicate the heads of two individuals.

Hejje:nu

The name *hejje:nu*, (in particular, the presence of the prefix *he-* 'largest') acknowledges the fact that this is the largest type of honeybee known to the Solega (the giant honeybee or *A. dorsata*). Colonies of the giant honeybee are common in high-altitude rain forests (*male ka:ḍu* or *ka:nu ka:ḍu*), although they may also be found in drier, lowland forest types (*na:ḍu ka:ḍu*).

In evergreen forests, giant honeybees prefer to live on very tall trees, showing a marked preference for the *soravilu* (*Acrocarpus fraxinifolius* Wight & Arnott Fabaceae) and *ba:ge/sele ba:ge* (*Albizia odoratissima* Bentham Fabaceae, *Albizia lebbek* Bentham Fabaceae) trees. Indeed, individual trees of these species may be well known across a range of Solega settlements as *je:nu mara* or 'bee/honey trees', due to the fact that they are home to a large number of giant honeybee colonies year after year. For instance, the *do:vu ma:vu ba:ge* is a single large *A. odoratissima* found near *ko:li ba:vi* hill, which attracts up to 50 giant honeybee colonies around the same time every year. Several other 'bee trees' are known to the Solega, and these, along with other locations where bees often nest, are remembered as mental maps of honey harvesting sites. In the following passage, a single consultant (MRM) is asked to recall the important honey harvesting sites known to him, and the directions for getting to these places.

> If you keep going past *doḍḍa sampage* (tree), there's a *soravilu* tree with bees. [There were] four *soravilu* trees [initially] – one or two have died, and there are still a couple left. If you keep going, you'll see another *soravilu* tree at *guṇḍu sikkida* waterfall. Ten or so bee colonies nest there. If you keep going uphill from there, you get to *gombegallu* village. If you climb uphill from there, you'll find *sikka sampage* (tree). Above *sikka sampage* is *aravilu* hill. A stream flows from there. It meets both the *doḍḍa sampage* and *sikka sampage* streams in the middle. If you keep going upstream of *sikka sampage*, you'll find an *aravilu kende* tree. About twenty colonies come to that tree. We harvest from there. It's a tree that's right below *aravilu* hill. It's growing out of a rock platform. Next, you can go uphill from *sikka sampage*. There you will see a *tekke soravilu* tree. About twenty

> bee colonies come to that tree. We harvest from that tree as well. If you walk a bit to the right from that tree, you get to *iṭṭu bu:di* – two or three *soravilu* trees grow there too. Bees nest there. We harvest from those trees as well. When you go up to the road from there, to *kambaḷi gadde* forest, you find the *jo:ḍu* [twin/joint] *turuve* trees. We harvest from the *jo:ḍu turuve*. *Jo:ḍu turuve* means the road goes in between, there's a tree on one side, and a tree on another. We call those two trees the *jo:ḍu turuve*. They're big trees – they meet in the middle [overhead]. You need to build a bridge to climb from one tree to the other.

The above passage not only contains references to individual trees from which honey is harvested, but also convincingly demonstrates the existence of a mental map of significant harvesting sites. Solega men eagerly await the annual migration of bees in February/March, and plan harvesting excursions in small groups of neighbors or relatives to 'bee trees' growing near their own village.

Giant honeybees start arriving in locations familiar to the Solega in March, at the time when the flowers of the *honne* (*Pterocarpus marsupium* Roxburgh Fabaceae) tree are in bloom. Following similar reports of honeybee migration from local communities in many parts of tropical Asia, scientists have confirmed that colonies of *A. dorsata* do embark on annual migrations of up to 200 km, and faithfully return to the same tree the following season (Dyer and Seeley 1994; Neumann et al. 2000). Apart from this very obvious annual pattern of appearance and disappearance that the giant honeybees exhibit, there is evidence that the Solega are aware of this species' stepwise migration behavior, which has frequently been reported in the scientific literature. In the following excerpt from an interview recorded in the village *Bu:ta:ni Po:ḍu*, the speaker contrasts the 'arrival' behavior of giant honeybees and Asiatic honeybees on the one hand, which appear to make more than one stop before deciding on a final hive location, and the stingless bee, which appears to choose a final hive location straight away:

> *Hejje:nu* arrives in the time of the *honne* flower... then *hejje:nu* goes to many different places, it goes all over the forest, *thuduve* also goes all over the forest, it's only *nesari* that (remains) exactly where it (first) lands.

Thuḍuve Je:nu

Thuḍuve je:nu (variously known as the Indian, Asiatic or Eastern honey bee, *A. cerana*) can be found in both evergreen forests, *ka:nu ka:ḍu*, or in dryer lowland regions, or *na:ḍu ka:ḍu*. Unlike the giant honeybee, with its preference for particular tree species (or even individual trees), some informants stated that the Asiatic honeybee is not picky about its nest site:

> Whenever it finds a home, any tree hollow (will do), they'll be inside, any tree with such hollows is fine...all of them, I can't name just one.

Asiatic honeybees will also readily nest in small rock crevices, even close to ground level. However, when asked to be more specific, some informants replied that this bee can often be found on *ne:ri*, *bejja* (*Anogeissus latifolia* Guillemette & Perrotet Combretaceae) and *karava:di* (*Persea macrantha* Kostermans Lauraceae) trees, and especially on the *koṭṭa:na beṇḍe* (*Kydia* sp. Roxburgh Malvaceae).

The *kencu thuḍuve* (the 'red' variety) and *kari thuḍuve* (the 'black' variety) may well be subspecies of *A. cerana*, as they are said to occupy rather different ecological niches. *Kencu thuḍuve* is to be found primarily in the dryer lowland forests, and on *bejja*, *kaggali* and *ka:rase* trees, whereas *kari thuḍuve* is said to occur in higher-altitude rainforests, or *male ka:ḍu*, usually on *beṇḍe*, *bejja*, *soravilu* and *puḍu ma:vu* trees, and in rocks.

Kaḍḍi Je:nu

Another bee species whose honey is eagerly sought after is *kaḍḍi je:nu* (the dwarf honeybee, *A. florea*). This is the smallest of the *Apis* species known to the Solega, and can be found in all forest types.

The dwarf honeybee is said to appear around the time that the *maruḷi* plant (*Indigofera* sp. Linnaeus Fabaceae) is in flower. When the *iṇḍã* trees are in bloom, however, the dwarf honeybee appears in the lowland forests, and in particular in the region where hill slopes meet flat land (*orrega:ḍu*). Certain conditions need to be fulfilled, however, for this bee to nest in a particular location: according to the Solega, a place needs to be open, *i.e.* not densely wooded (*bailu*), and cool (*shi:ta*), for dwarf honeybees to take up residence there. In locales where such conditions exist, this bee will be found on bushes, on clumps of mistletoe (*uppilu*) growing on *bejja* trees, and even on bamboo canes. The name *kaḍḍi je:nu* recalls the fact that this species' comb completely encloses part of the small twig, or *kaḍḍi*, to which it is attached.

Nesari Je:nu
One species of stingless bee is known to the Solega. *Nesari je:nu* (*T. iridipennis*) is a tiny black bee, which is frequently found in tree hollows. There was some disagreement regarding its preferred habitat, with some Solega claiming that it occurred in all forest types, and others stating that it was more common in the dryer, lowland forests, especially at the hill slope-flat land interface, and in less densely wooded areas.

Stingless bees can be found on *bejja* and *ka:rasa* trees in dry, open country (*begga:ḍu*), as well as on *asuvara* (*Commiphora caudata* Engler Burseraceae). It is possible to find several (5-10) colonies on a single tree. The *nesari* honey, to which powerful disease-combating properties are ascribed, starts to be available from the time that the *te:ku* (teak; *Tectona grandis* Linnaeus Lamiaceae) and *beṇḍe* trees are in flower (usually November-December):

> You need to eat five *a:la* of pure honey, if you eat that, all...the diseases that afflict a person go away.

The nests of this stingless bee are difficult to observe directly, because of their small size, and their location within tree hollows and rock cavities. However, the Solega maintain that the brood area is separate from the honey and pollen storage areas.

Aspects of Bee Life History
The most impressive aspect of the honeybee traditional ecological knowledge (TEK) of the Solega is the detailed and in-depth awareness of the life cycle of honeybees, including, in particular, astonishingly accurate elements of honeybee reproductive biology. It is not an easy task for a lay observer to determine a honeybee's gender, while the sexual habits of the reproductive members of a honeybee colony are also extremely hard to observe. In the European honeybee *A. mellifera* at least, mating occurs once in a queen's lifetime, when she leaves the hive for a 'nuptial flight.' During this time, she is eagerly sought out by drones that detect her pheromones, chase her, and mate with her while in flight; the queen may mate with several drones, and stores their sperm within her body for life.

Knowledge of bee genders in Europe – which has a long history of beekeeping – did not emerge until the late 17th century, when Dutch biologist Jan Swammerdam decided to look at the internal organs of the so-called 'king' bee under the newly-invented microscope, and discovered that 'he' had ovaries. Until then, it had been widely accepted that only a male could be the leader of a hive, and the honeybee colony was often used in political and sociological writings of the time as an allegory of kingly power, wise and benevolent rule, loyalty, industry and a unity of purpose (Campbell 2006). It is against this back-drop of the western intellectual tradition that I wish to showcase the honeybee knowledge of the Solega.

Honeybee gender and reproduction
Individual worker honeybees are called *kunni* in Solega, which is also the word for 'girl,' while the 'leader' of the hive is called *ra:ṇi*, or 'queen.' This is consistent with the fact that at any given time, most, if not all, the insects in a honeybee colony, including the queen, are biologically female. Already, it is clear that certain basic facts that eluded the beekeeping societies of Europe are known to the honey-gathering Solega, even in the absence of technological developments such as microscopes and observation hives – these are hives with a clear glass (or recently, Perspex) wall that allows observation of the interior of the colony.

As has been made clear previously, the Solega are not beekeepers, and are instead totally dependent on the seasonal migration of honeybees. Their observations, then, are based on the frequent, but brief, chance encounters they have with bees when out foraging, or the longer, but less frequent periods of scrutiny when the honey from bee-trees is systematically harvested. Beekeepers, in contrast, have far more opportunities to tend, examine and manipulate several hives, which would be available year-round. A good example of a non-industrial beekeeping society with which to compare Solega TEK is the writings of Aristotle, widely regarded as the 'father of natural history.' In his books, *Generation of Animals* and *History of Animals*, one finds sections where Aristotle presents the honeybee TEK of his Greek contemporaries (some of whom are beekeepers), and analyzes this information to deduce certain features of honeybee biology. Of course, Aristotle had the advantage of being able to lead a life of leisure, and of having beekeepers to consult with. Still, it seems reasonable to assume that his observations, and those of his contemporaries, were made with little more than the basic human senses, blended with a healthy dose of deductive reasoning.

Some relevant aspects of contemporary scientific understanding of honeybee reproduction are first

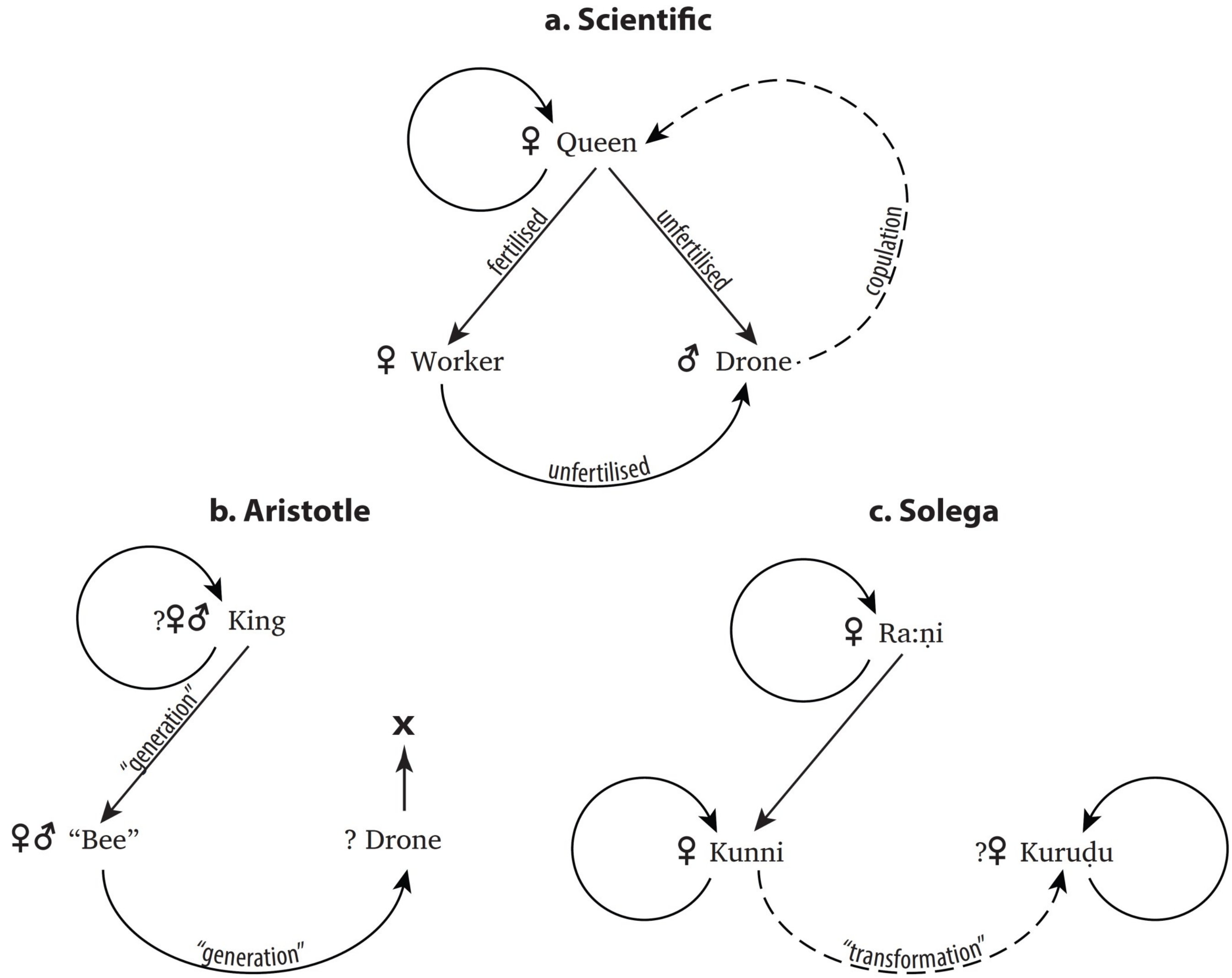

Figure 2. The three conceptions of honeybee reproduction and behavior described in this paper.

presented in brief: as mentioned above, the queen and all the workers (her daughters) are female, while only the drones are male. The queen mates with one or more drones on nuptial flights outside the hive, and produces workers from fertilized eggs, and drones from unfertilized eggs (Figure 2a). When a queen leaves the hive, or is lost, the hive will descend into anarchy unless new queens, produced by the old one, start to develop. Otherwise, the female workers lose their pheromone-induced physiological inhibitions, and start laying unfertilized drone eggs. The worker population crashes due to a lack of new fertilized eggs, and the colony perishes.

Aristotle takes it as a given that the leader of a hive is a "king" (Figure 2b). He is aware of the existence of two other types of individuals – "bees" (workers) and "drones" – among a colony's members, but on the topic of gender, Aristotle has the following to say about certain hypotheses that were being offered by other commentators:

> Nor is it reasonable to hold that "bees" are female and drones male; because Nature does not assign defensive weapons to any female creature; yet while drones are without a sting, all "bees" have one. Nor is the converse view reasonable, that "bees" are male and drones female, because no male creatures make a habit of taking trouble over their young, whereas in fact "bees" do (Aristotle 1953:12).

His rejection of the first hypothesis, we now know, was far too hasty. His detailed and accurate descriptions of many aspects of honeybee natural history notwithstanding, Aristotle failed to gain a complete understanding of honeybee reproduction, possibly due to the fact that it is very difficult to observe a drone copulate with a queen. Hence, he writes:

> The generation of bees is a great puzzle… either (i) each kind generates its own kind, or (ii) one of the three kinds generates the others, or (iii) one kind unites with another kind (Aristotle 1953:10).

He adds that "bees" (and possibly also the king, but the language dealing with this point is vague) contain within themselves "*the male as well as the female, just as plants do,*" and that they are able to *generate* offspring without recourse to copulation. Eventually, however, by eliminating various untenable possibilities, and by drawing heavily on key observations of beekeepers, such as the following,

> …the brood of the drones is produced even when there is no drone present to start with, whereas young "bees" are produced only if the kings are present…

Aristotle concluded that:

> …the leaders generate their own kind and another kind as well, (viz. the "bees"); while the "bees" generate another kind (the drones), but *not* their own kind… necessity requires that the drones shall have been deprived even of generating some other kind. And this is what is found to be the case in actual fact: they are generated themselves, but generate no other creature…

The Solega possess detailed information on the breeding schedules of at least some of the four named bee species. Moreover, there is a clear understanding that the pollen and nectar gathered by the colony are for the purpose of nourishing new brood. This was made clear by explicit statements from consultants that the intensive collection of honey and pollen tended to accompany the rearing of brood. In fact, it would be unusual to find honey in a hive which did not also contain some amount of brood.

Unlike the 'scientific' and Aristotelian conceptions of honeybee reproduction, the Solega believe that each honeybee caste is able to generate other individuals like itself (Figure 2c). There are complications, however, because the *ra:ṇi* 'queen bee' is above all the *awwe* 'mother' of all the bees, and is responsible for, presumably, the first generation of *kunni* 'daughter' (worker bees) in a newly established colony. Moreover, the drones can be generated by another mechanism, namely the transformation of *kunni* into the fatter, stingless, unproductive counterparts through the loss of a sting. The following six extracts from three speakers sum up the Solega position on the origin of honeybee castes:

> 1) As for the queen bee, she's like a mother for all the bees…she looks after them carefully. However many bees there are, she never leaves them, she looks after all of them.
>
> 2) The small bees [workers] come from the queen. She is their mother.
>
> 3) When eggs are laid, the drone bee – it lays on one spot, there, by the side of the hive. The other bees do it in another spot. Just like the drones, whatever eggs they lay turn into young bees just like themselves. The young of ordinary bees turn into ordinary bees (like their parents)… when a (new) hive is built, the queen lays eggs in it. The queen's eggs hatch into queens just like her.
>
> 4) The sting breaks off, from its (the worker's) bottom. When the sting breaks off, it does not have another sting – that's how it becomes a drone. It loses its poison.
>
> 5) The sting of the (worker) bee is lost, it goes away. At that time, some die. Some that remain turn into fat workers… once their sting goes away, they no longer have the strength to work. Their work slows down. While they possess their sting, they work much faster, because they're like, "We're in good health".
>
> 6) New queens will emerge from only those spots (cells of the honeycomb) that the (existing) queen has sat on.

The above quotes were offered as explanations of honeybee biology in general, and without reference to any particular species. However, it would be safe to assume that this information was gained mostly through observation of *A. dorsata* and *A. cerana* colonies, as these are more frequently encountered, and the larger size of these species makes it easier to note the behavior of individual insects. Extract 1, 2 and 3 indicate that while each caste can generate its own kind, the queen is ultimately the progenitor of the hive. Extracts 4 and 5, on the other hand, illustrate the belief that since drones are fatter and less active than the workers, and also stingless, they must be ex-workers who are transformed after losing their sting (the loss of the sting is almost always observed when a worker bee stings a human). The sting, then, is not only a defensive weapon and a source of the bees' intensely algesic venom, but also the basis of their motivation to forage. While these statements echo elements of the deductive logic of Aristotle, it is in fact the last extract (6) which is the most intriguing, and points to possibly the key observation responsible for the elevated status of the *ra:ṇi* 'queen' in the Solega system – the fact that only queens can produce other queens. As a result, it is the queen who is responsible for honeybee reproduction at the level of the hive as a superorganism, a phenomenon which will be discussed in the next section.

Swarming

Swarming is a natural process in honeybee colonies, and occurs mainly in response to overcrowding. The existing queen starts to lay eggs in special queen cells, which then develop into new queens. The old queen leaves the hive with about half the workers, and occupies a new nesting site, stopping along the way at various places. When a swarm lands at one of these intermediate sites, scout bees fly off in all directions to locate potential nest sites. They return to the main swarm and perform dances that advertise the locations they have found. When many scouts have agreed on a single nest site, the swarm flies off to the new location, and takes up residence there.

Aristotle says little about this phenomenon, but he does make note of the facts that the hive's leaders may sometimes be killed by other leaders, especially during periods of adverse environmental conditions.

> Many of their rulers are also frequently killed, and especially the bad ones, in order that the swarm may be dispersed by the numbers. They are more disposed to kill them when the swarm is not fruitful... (Aristotle 1991:26)

He does, however, mention occurrences of the 'king' leaving the hive in the company of many bees, although he neglects to explain why.

> The king bees never leave the hives, either for food or any other purpose, except with the whole swarm... They say also that, when king is unable to fly, he is carried by the swarm; and if he perishes, the whole swarm dies with him. (Aristotle 1991:27)

One of the first discussions of the causes of swarming behavior appears to have been written by the English apiarist John Gedde in his monograph *The English Apiary, or, The Compleat Bee-Master* (Gedde 1721). Here, he blames low food stocks and inclement weather, coupled with overcrowding in the hive, for forcing bees to abandon their old nest.

> …moist weather gives them two causes of swarming, plenty of *bees*, and penury of honey; and so neither winds, nor clouds, nor rain can stay them. (p. 40)

The Solega have quite explicit and accurate knowledge of why a swarm leaves its natal colony, and of the events that occur between departure and arrival at a new nest location. Here, too, population increase in the original colony is held responsible for triggering a swarming episode:

> 1) What does the queen bee do? She has produced lots of offspring, and that family gets a new queen. When there's a new queen, the rest of the family is divided (into two). But only when the queen reproduces (new queens). If not, it remains as one family. When one of the queens gets a part of the family, it goes away and builds a new house. That queen repeats the process in that family as well. Thus, by dividing over and over, you get many bee hives.
>
> 2) That's how bee(hive)s proliferate. However many queen bees there are, that's how many families you get. When (the queen) wants to grow its family, it makes other bees from the comb. When that happens, you get lots of bees. When the queen lays eggs and produces (queen) offspring, the family divides into two.

The second extract presented above contains more or less the same content as the first, but offers, almost in passing, a valuable insight – that 'reproduction' in bees really should be understood as two parallel phenomena taking place on two time scales. The first is the growth of a colony's population, which continues practically every day, and the second is the division of colonies into daughter colonies through swarming, which only happens a few times in a year.

Knowledge of what happens to a swarm after it leaves its original nest site is arguably the most fascinating and impressive piece of Solega honeybee TEK. First, it is said, the swarm will often land on a tree, which serves as a temporary resting place. Such behavior is also seen after honey has been harvested from a hive by humans, and the surviving bees are forced to look for a new nest site:

> Speaker 1: When people go and harvest honey from a hive, the queen and the other bees stay in the same spot for a night or so.
>
> Speaker 2: (For) one or two days. Then the bees do another thing, the bees simply go and sit on a tree (without nesting). Those bees are called *togaruguḍukã* ('sap drinkers'). Then they land there and make inquiries regarding possible locations to nest in.

The exact way in which bees "make inquiries" was elucidated by one consultant from *Bu:ta:ṇi po:ḍu* village, who depicted the process as a conversation between a scout bee and a potential host tree.

> The bees come from elsewhere, and land on an unoccupied tree. Let's take the giant bee. When the giant bee (swarm) comes and sits on a tree, it does not stay there long. It drinks the sap on that tree. That's when we call it *togaruguḍukã*. And as it sits on that tree, it also looks for a home on other trees… It finds things out by touch. It's become fussy. It goes to another tree and sits on a branch in order to find things out through touch. And then it moves on to another tree again. And when it moves, five or six individuals (first) go to a tree to determine whether it would make a good home or not. The bees are smart. They ask the tree, "O tree! There are many in our household; will you have the strength to bear us all? Or will you not?" That's what they need to ask the tree. Then the *honne* tree says, "O bees! I will support all 1,006 of you; come and sit on all my branches, for I will support you." That's how it reassures them. As soon as they're reassured, those bees go back, and say to the rest, "Yes, come on, let's go! Let's go, our home is there!" They all go there (to the new tree). At the new tree, after eight days or so, they start to build new comb.

Conclusion

The Aristotelian conception of honeybee natural history consisted of accurate insights based on available evidence, as well as (at the time) logical, educated guesswork, in those instances where key evidence was not readily available. The Solega appear to have built up their picture of honeybee biology on similar principles. As a different evidence set was available to them, however (the Solega only gather wild honey from the forest; they have never been beekeepers), their final notion of honeybee natural history must necessarily differ from that presented in Aristotle's writings, who frequently cites apiarists' reports to back up his claims. Nevertheless, their interactions with wild honeybees over countless generations have enabled the Solega to attain an understanding of this important insect's behavior, migration, reproduction and ecology, which is totally consistent with their observations and experiences.

How might the Solega have arrived at their conception of honeybee reproduction? In the absence of longitudinal data of any significant time depth, one might hypothesize that some of the mechanisms described in Pereira and Gupta (1993) are in play: individuals or groups of individuals innovate (in this case, propose an explanation for a poorly-understood phenomenon, such as swarming), the innovation is shared with and tested by the individuals' peers, and, if found to be useful, is formalized and accepted by the wider community. More specifically, the development of the idea that the queen and worker bees are female may have been facilitated the Solega's cultural milieu – their belief in powerful female deities, for example – as well as by other domains of ethnobiological knowledge: perhaps the observation that elephant herds tend to be led by a matriarch. Some younger Solega men have attended beekeeping workshops organized by community-development-oriented NGOs, but for the purpose of this study, it was established at the very outset that none of the consultants interviewed here had attended such a workshop. In any case, all stated unambiguously that the information they were providing me had been passed down from their parents. Another, and perhaps the most convincing, piece of evidence in favor of an indigenous origin of the information presented here is the presence of key points of disagreement between the Solega's account of honeybee reproduction and the accepted biological facts – the origin of drones is an illustrative example. The Solega explanations taken together, even if not wholly accurate from a biologist's point of view, form a sophisticated and comprehensive account of the mysterious world of honeybee reproduction.

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Biosketch

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