M. Economic of Pollination

One well-worn, and probably accurate, estimate says that one-third of the human diet can be traced directly, or indirectly, to bee pollination. This estimate is probably more accurate for human diets in developed countries.

About 130 agricultural plants in the United States are pollinated by bees, and the annual value of honey bee pollination to U.S. agriculture is estimated at over $9 billion.

The annual benefit of honey bee pollination in Canada is estimated at $443 million, and over 47,000 colony rentals take place every year. Every dollar spent on colony rental fees in Québec returns $41 for blueberries and $192 for apples.

Honey bee rental for commercial pollination is a viable component of the beekeeping industries. Commercial beekeepers in this region earned more than 60 percent of their annual gross revenues from colony rentals in 1998 and 72 percent in 1995. Demand exceeded supply during much of the 1990s and this led to favorable market conditions for beekeepers. The average rental price per colony increased from $19.25 in 1992 to $31.55 in 1996. During the same period, the average annual revenue from colony rentals increased a remarkable 246 percent from $37,993 in 1992 to $131,625 in 1996.

The economic value of bee pollination goes beyond production agriculture because bees pollinate more than just crop plants. Bees pollinate more than 16 percent of the flowering plant species in the world.

French scientists and a UFZ German scientist found that the worldwide economic value of the pollination service provided by insect pollinators, bees mainly, was €153 billion* in 2005 for the main crops that feed the world. This figure amounted to 9.5% of the total value of the world agricultural food production. The study also determined that pollinator disappearance would translate into a consumer surplus loss estimated between €190 to €310 billion. The results of this study on the economic valuation of the vulnerability of world agriculture confronted with pollinator decline are published in the journal Ecological Economics.

SETTING POLLINATION FEES:

Pollination fees are meant to compensate beekeepers for the loss of honey and the loss of bee populations incurred as well as for the extra work distributing colonies in relatively small sets. These fees can vary widely, from 0 to $100/colony depending on supply-demand, the time of year and the crop in question.

$100/colony pollination fees are rare but could occur under difficult placement circumstances such as cage pollination, experimental plots where bees must be moved in and out on precise dates or in the middle of a cranberry bog.

Beekeepers generally set pollination prices too low because they look at a pollination job as a location rather than as a valuable service. Once this mind-set is established, receiving a reasonable pollination fee takes a back seat to keeping the location.

For Washington State the average colony rental fee for 2008 was $81.75
FOR MORE INFO: see PACIFIC NW HONEY BEE POLLINATION ECONOMICS SURVEY
http://www.wasba.org/newsletters/WSBA%20Newsletter%202009 -01.pdf

L. Greenhouses, Cage-Pollination

Honey bees & greenhouse/cage pollination: http://forums.gardenweb.com/forums/load/bees/msg0320301511448.html

Honey bees are used in cage & greenhouse pollination seasonally and are most effective in large scale operations.

The inside of a beehive is so warm, in a greenhouse, that the bees will follow their instincts and fly a lot further than a cleansing flight. They'll rattle themselves silly on the glass, frustratingly by to fly by the bearing of the sun.

Stingless bees & greenhouse/cage pollination: http://www.agnet.org/library/nc/138a/

Stingless honeybees have a rather small forage area. They have a flight range of only about 200 m, which means that they are never far from their hive. This makes them very suitable for greenhouses. In contrast, the flight of the common honeybee may cover more than 2 km.

It is important that bees chosen to pollinate a crop are attracted to that kind of flower. The common honeybee will forage on a wide range of crops (more than 80% of cultivated plants). Scientists are still working out which plants are favored by different species of stingless honeybee. The Australian stingless honeybee, Trigonia carbonaria, is a promising species. It is known to be a good pollinator of macadamia trees. It also quickly adapts to new plants it has not encountered before.

Bumblebee & greenhouse/cage pollination: http://resources.cas.psu.edu/ipm/BVB/bees.pdf

Using bumble bees for pollination is an effective alternative and can completely replace manual pollination. In addition to saving on labor, bumble bee pollination has many advantages. These advantages include:

- Active at low temperatures (41°F), and windy and cloudy conditions.
- Effective in greenhouses, high tunnels and in open air.
- Higher yields and large, high quality fruit in crops such as tomatoes, peppers and blueberries.

Bumble bee colonies are shipped to growers in completely maintenance-free hives. The housing is made of solid, recyclable cardboard with a moisture resistant coating. The hive has two flight openings. The standard flight opening is used under normal conditions. A tapered tube is attached to hole no. 2 which creates a lock in system. When this valve is open, the bumble bees can enter, but are unable to get out. This is a convenient option if the hive needs to be removed from the greenhouse. The hives are supplied with sugar water for the total life expectancy of the hive, since crops such as tomatoes have blossoms that do not produce nectar.

Working with bees in cage pollination: www.ars-grin.gov/ars/PacWest/Pullman/Curators/Docs/VIIc3%20Hanlin%20 - %20**Pollinators**.ppt

In large operations experiments are being done with cage pollination

Honey bees (*Apis mellifera*) – the primary pollinator *North Central Regional Plant Introduction Station* (*NCRPIS*)

- Placed in ca 800 cages per year, year round
- Used in both field and greenhouse cages
- Domiciles can be reused in other cages throughout the growing season
- Social bee with 2000 to 4000 bees per cage
- Traditionally used to pollinate many different plants and for honey production; at NCRPIS used on many plants but honey fed back to the bees
- Forage best at 15 to 32 C (60 to 90 F)
- Rearing is well established but costly due to the equipment and amount of continuing care

More Info: on cage pollination and greenhouse of diverse insect See, "The Art of Pollination In Cages with Insects

K. Pollen Inserts

Definition:

A pollen insert is a device that forces bees leaving the hive to crawl through a shallow tray containing pollen from the desired pollenizer. Pollen adheres to the legs and body of each foraging bee to enable it to cross-pollinate the blossoms it visits.

When using a pollen insert, place hives in the crop after blossoms have partially opened (earlier for sweet cherries, later for pears). This encourages more bees to work the fruit blossoms in the immediate surroundings, rather than foraging elsewhere. This recommendation is extremely important to ensure the effective use of pollen inserts. Have 5 colonies per hectare when using pollen inserts.

FAQs on pollen inserts/pollen:

1. Which strength pollen should be used with the insert?
Use only regular strength pollen. Pollens mixed w/ carrier are intended for air application only--not inserts.

2. How many inserts should be used per acre?
Use one per acre, and place them on the strongest hives if there seems to be a difference in hive strength.

3. When should the inserts be placed on the hives?
They should be placed on the hives a day or two ahead of the day that you expect to make the first application of pollen so that the bees become accustomed to them; however advanced placement is not essential because the insert is such a minor restriction. Regardless of the day of placement, the insert should be placed on the hive when bee flight is minimal--either late in the day when most flight has ceased or early in the morning before it has begun.

4. How much pollen should be used per acre?
For apples, cherries, pears,and plums, a minimum of forty grams of regular strength pollen per acre is recommended. For almonds a minimum of fifty grams per acre is recommended. The use of larger amounts can be expected to produce a greater fruit set.

5. When are the trees ready for pollen?
Trees bloom over an extended period of time. Because of this, pollen should be applied on two different days. Use 1/2 of the recommended amount of pollen on the day that the trees are at 15% to 25% bloom. Apply the remaining 1/2 on the day that the trees are at 40% to 60% bloom. Depending on the weather, the application days may be one after the other, or there may be a day or two in between. During very cool weather the application days may be three or more days apart. It is very important to get an ample amount of pollen into the hives on the application days. We recommend that a minimum of 20 grams be applied on each application day. If bee flight is so poor that this amount is not carried out, then dusting applications should be used.

6. When should the pollen be placed in the insert?
The pollen should be placed in the insert only when there is strong bee activity--100 or more bees per minute entering and leaving the hive. This activity level will occur at temperatures around 60 degrees F. If there is little or no bee activity, the pollen will not be spread and will be wasted.

7. How much pollen should be placed in each insert each time?
One well-rounded but not heaping teaspoon of pollen should be placed in each insert each time. This amounts to approximately five grams of pollen. Some of each teaspoon should be sprinkled along the narrow strip on top of the insert so that the bees that leave the hive in an upside down position will pick up that pollen as they leave the hive. Most of the teaspoon should be spread along the ramp sloping into the entrance of the hive.

8. How often should pollen be added to the insert?
As soon as the bees have removed all or almost all of each rounded teaspoon of pollen, add an additional teaspoon of pollen. The time between applications determined by bee activity. Strong activity = 15min..

9. How much time will it take each day to cover my acreage?
The pollination process is quite fast. The pollen application works in a circle. Beginning at the first bee drop, add a teaspoon to each insert, go to the second bee drop and add a teaspoon to each of those inserts, continue this process until each bee drop has been visited, return to the first hives and repeat the procedure until the days application is completed. On larger acreages more than one person should be used to load the inserts.

10. Should special clothing be worn during the application?
Yes. A beekeeper hat, veil, and gloves should be worn during applications for protection against bee stings. Heavy, loose fitting clothing should also be worn. Bee stings are uncommon but they may occur. Work from the side of the beehive whenever possible, doing so will keep you out of the bee's flight path. We can provide the hat, veil and gloves to you at our cost.

I. Pollination planning and colony location

Hive placement http://www.ent.uga.edu/bees/Pollination/Managing_Honey_Bees.htm

Although honey bees can fly several miles, they prefer to work within 300 feet of their hive. For this reason, by putting groups of hives at 500-foot intervals (about 0.1 mile) within a field, you can place the whole field within ordinary bee foraging range. If the interior of a field is inaccessible, you can group hives around the edges. In these cases, the center of the field is less likely to be visited by bees, but you can remedy this by putting more colonies in the center-most groups along the field edge; this increases competition and forces bees to forage deeper into the field.

Place hives in ample sunlight and do not place them in low areas which accumulate cool, damp air. Chilly, shaded bees are poor pollinators. As much as possible, keep hives away from farm workers, pedestrians and livestock.

If possible, place the colonies in sheltered locations so their entrances face the early morning sun. This will encourage earlier bee activity as the hive warms in the morning. Pallets of hives or individual hives should be spread out around the field to maximize the spread of floral visitation

From Apprentice literature

The apiary location is important. It should be accessible by car or truck so the honey may be easily carried away. It should be a sunny spot and have good air drainage. The must be protection from the prevailing winds with a building, fence, hedge, or a specially made wind break.

Arrangement of the hives in the apiary is important. They are usually placed in pairs, with several feet between each pair, so that the hives may easily be worked from the side. Scattering them about the apiary helps prevent the bees from returning to the wrong hive (drifting). For maximum honey production, the hives should not be placed in a straight line. Hives should face south to east to receive maximum early morning sunlight. Colonies are more easily worked more gentle, and stay stronger and healthier if they have full sunlight most of the day. Hives should be set on wooden pallets, boards, or concrete blocks no more than four to six inches off the ground.

Pest management during pollination

Avoid use of insecticides when flower buds are open to prevent killing pollinators. Some products are bee safe, but the label should be followed carefully if using them during bloom. Beehives should be removed immediately after pollination if post-bloom pesticide applications are planned. By monitoring for pest problems carefully during bloom, growers can help minimize the need for pest control. If an insecticide application is necessary during bloom, compounds that are least toxic to bees should be used and applied when bees are not foraging, with careful observation of the pollinator-restrictions on the label.

The flowers that are visited by bees are typically:

- Full of nectar
- Brightly colored with petals that are usually blue or yellow or a mixture of these (bees cannot see red)
- Sweetly aromatic or have a minty fragrance
- Open in daytime
- Provide landing platforms
- Often bilaterally symmetrical (one side of the flower is a mirror image of the other)
- Flowers are often tubular with nectar at base of tube

Squash Bees, Peponapis sp native solitary bees of two genera, *Peponapis* and *Xenoglossa*, "squash bees". Look at squash's flowers during the first few hours after sunrise. Male squash bees will be resting between flowers, searching for mates. By noon, they will be fast asleep in the withered flowers. Females forage at the flowers of squashes, pumpkins and gourds, their sole pollen hosts. The most widespread species, *Peponapis pruinosa*, is found from Quebec to Mexico, wherever squashes are grown.

Sunflower Bees, Eumegachile pugnata The Pacific Coast to Quebec and the New England states, south to Texas and Georgia, June to September.

Halictidae, Dialictus zephrum (Common eastern SWEAT BEE).

Small and dark, they have little hair. Nests in the ground. They have societies, related bees assist on another. They are attracted to the salt in human perspiration. They sting if squeezed or squashed against the flesh but their sting is quite mild 1.0 on the Schmidt sting pain index, almost painless. They are black, brown, red, or metallic green, sometimes with yellow markigs.

Halictidae, Halictini, Genus Sphecodes (parasitic sweat bees) Latreille

Alkali Bee, Halictidae, Nomia melanderi solitary ground nesting bee native to western North America. As its name suggests, it can be found nesting in alkali soil. It prefers to nest in bare soil that remains moist but not wet, and dry on top. This occurs naturally in areas where a layer of hard pan exists in alkali soils. The alkali salts seal the top of the soil, holding in the moisture.

Cuckoo Bee parasites, in that the female cuckoo bee lays her eggs in the nest of other bees, primarily diggers and Andrenids. Cuckoos are also said to be kleptoparasites, stealing honey and pollen collected by others. Look for cuckoo bees flying low over the ground and foliage, hunting for foraging and nesting victims.

Oxaeid Bee, Ptiloglossa arizonensis Prefer to pollinate between 5 and 6 in the morning. This solitary bee nests Underground.

Orchard Mason Bee, Osmia lignaria These prepare nests in preexisting cavities or live in collections of individual nests. They have long tongues and special pollen carrying hairs on the bottom of the abdomen. They are useful as agriculture pollinators. Mason is a common name for solitary bees that build part or all of their nests w/ mud or plant fiber chewed into a paste Some species construct mud nests on exposed surfaces such as rocks. Some in tunnels bored in wood. Most are smaller than honey bees and some the same size or larger. Some species are metallic green or bluish in color. They are common in the Western U.S. especially in forested regions.

Hornfaced Bee, Osmia cornifrons. Used commercially for several decades in Japan to pollinate apples, it's now in the U.S. A single hornfaced bee can visit 15 flowers in a minute. This solitary bee nests in reeds, tubes and holes in wood.

Blueberry polinator, Osmia ribifloris one of several species referred to as a blueberry bee**,** is a megachilid bee native to the coastal mountains of southern California. This solitary bee normally gathers pollen from manzanita, but will pollinate blueberries, and is sometimes used commercially for this purpose.Plaster or

Polyester Bee, Colletes inaequalis These dig holes & tunnels lining them w/ plastic-like glandular secretionMiner Bees, Anthophora abrupta..... **Photo and more**Shaggy Fuzzyfoot Bee,

Anthophora pilipes villosula Fat shaggy fast flying bee that buzz-pollinates In this type of pollination, the bee creates a vibration that releases the pollen from inside long, tubelike anthers. Shaggy fuzzyfoots pollinate in the rain. They pollinate blueberries, apples, and other crops for about 6 weeks in the spring. During this time, females lay eggs in mud cells. Bee larvae grow inside them during the summer, pupate in the fall, become adults, and hibernate in the cells over winter. They're best adapted to a moist, warm climate and can survive mild winters.

Africanized Honeybees In 1957, people imported these to Brazil and inadvertently released them into the wild. They mated with European honeybees, creating Africanized honeybees. Nearly identical to European honeybees, but they tend to be far more aggressive when defending their nests. The media has referred to them as "killer bees." They have spread from Brazil to other parts of Central and South America and southern portions of the United States, including Florida, California and Arizona. These bees are most dangerous when people and animals venture too close to these nests.

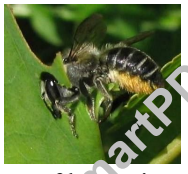
Bumblebees, B. parasitic genus Psythirus (ashtoni, citrinus) large and hairy Black & yellow; these display social behavior, living in colonies. Worker and drones perish in cool climate Winters. Young, fertile queens survive in hibernation. Some life in deserted holes made by other animals.

Carder bee, Anthidium sp.: A twig nesting bee that uses furry plant hairs in it's nest.

Carpenter Bees, Xylocopa virginica These sollitary, cannot prepare wax, travel long distances, nests are in flower stalks or wood, they make tunnels in solid wood, they make tunnels in thus their name. There will be a pile of sawdust near nest entrance. They are large, fuzzy, black & yellow bees 2 to 2 ½ inches in length. They look like a bumble bee but lack the furry abdomen.

Digger Bees, Anthophoridae Long tongues, fly very fast. These excavate nests in wood Or stay in the ground solitarily or socially. Pollen is carried on brushy areas close to the middle of the hind leg and are excellent pollenators. Carpenter bees belong to the digger bee family.

Digger Bees, Mellisodes communis.....**Photo & more**



leafcutting bee, Megachile rotundata non-aggressive and mild sting this bee cuts the leaves of plats to form nest cells in soft, rotted wood or in stems of large pity plants such as roses. Native to the Western U.S. they are essential pollinators of wild plants. Some are semi domesticated and used to pollinate alfalfa seed.

H. Other Species of Bees

Types of Bees http://animals.howstuffworks.com/insects/bee3.htm

In scientific terms, bees are in the insect superfamily *Apodiea.* This superfamily includes lots of families, subfamilies, tribes and approximately 20,000 bee species. The bees in each family have traits in common, like methods for building nests. Different species usually have different physical traits, like wing shape or tongue length.

Social bees

Many people are most familiar with honeybees and bumblebees. These are both **social** bees -- they live in large groups. Social bees use waxy secretions from their bodies to build large nests and containers in which to store food and raise young. A third type of social bee is the **stingless** bee. Stingless bees are native to tropical areas, where some societies use them for honey production. Until recently, stingless bee husbandry was common in the Mayan regions of South America, but the practice has nearly disappeared in the last 20 years.

Solitary bees

Many people are most familiar with social bees because they can be more visible than solitary bees. Many social species produce substances that people use, like honey and beeswax, and people can see large groups of social bees feeding in orchards and gardens. But most bees aren't social -- less than 15 percent of bees live in colonies. The rest are solitary. They may exhibit some social tendencies, but they don't build large hives or store lots of extra honey. Instead, they build small nests that are big enough to hold a few eggs or a single egg. Sometimes, lots of solitary bees build their nests close together, but with the exception of mating and the occasional group defense of the nest site, these bees do not usually interact with each other.

Lots of solitary bees are known for how they make their nests. They may use cerumen, a type of wax secreted from their bodies, or propolis, a glue bees make from tree resins. Many bees add other materials to these substances. For example:

- Carpenter bees bore holes in unpainted, unfinished wood. Some people mistake carpenter bees for bumblebees
- Plasterer bees dig holes and tunnels, lining them with a plaster-like glandular secretion.
- Leafcutter bees use their mouth parts to cut pieces of leaves, which they use to line their nests.
- Mason bees, which are in the same family as leafcutter bees, use their saliva and secretions from their maxillary glands to glue sand and pebbles together.
- Carder bees collect the furry or woolly parts of plants to line their nests.

Parasitic bees

Other bees take advantage of existing materials when they build their nests. Some use empty termite hills or wasp nests. A few species lay their eggs in empty snail shells, either dividing the cell into chambers using glandular secretions or laying one egg in each shell. A few bees, known as cuckoo bees, are parasitic - they lay their eggs in the nests of other bees. Some cuckoo bees don't have any structures for collecting pollen, since they rely on other bees' pollen to feed their young.

ESTABLISHING LONG-TERM RELATIONSHIPS http://www.beesource.com/pov/traynor/bboct1996.htm

Long-term pollination arrangements are best for both beekeepers and growers - it's a hassle to line up new growers (or beekeepers) each year. The 2 keys to establishing a successful long-term relationship with a grower are the same as the ingredients of a successful marriage: communication and mutual respect.

Although the pollination season lasts only a short time, keep in touch with your grower throughout the year. Let him know that you (and your bees) are alive and well and are already planning for next year's pollination. Keep abreast of what's happening on his ranch - has he added or reduced acreage, sold the ranch, etc. Beekeepers that don't keep in touch can sometimes get an unpleasant last-minute surprise. Consider sending out a newsletter to keep in touch; such a newsletter could include beekeeping cost studies from a respected source (4), an account of problems beekeepers are facing, or independent studies showing the value of bees for a grower's crop. Be aware of problems your grower is facing - consider subscribing to ag publications that could provide such details so that you can intelligently discuss his crop; let him know that you have an interest in his business and that your sole concern is not simply collecting a pollination fee.

Communication just prior to delivery time is extremely important. The very worst feeling a grower can have is to see his flowers (his livelihood) on the verge of opening and be unable to contact his beekeeper. In the days leading up to bloom, call your growers to let them know when the hives will be delivered. Always have someone by your phone round-the-clock during bee delivery time even if it means hiring an answering service for a short period of time - a live person is far superior to a machine during this period. If you make enough preparatory calls (pre-emptive strikes) you could well go through the delivery season without a single grower calling you. Set prices for a given season at least 3 months prior to bloom. By doing so you are indirectly telling the grower "I want your business and respect the fact that you may want or need to shop around for prices but I am confident that the quality of my product and service will cause you to decide to stick with me." There is no reason why a beekeeper can't set pollination prices 6 months ahead of time. Throwing a 10% price increase (no matter how justified) at a grower just prior to bloom shows an almost contemptuous lack of respect that often elicits a reciprocal lack of respect. Once you set your price (3 to 6 months in advance) don't change it (up or down) no matter how much pressure you feel - establish a reputation for sticking to your word.

G. Maintaining good public relations

Pollination/HoneyBee Etiquette http://www.mainebee.com/tips/pollin_etiquette.php

The proper placement of honey bee colonies for crop pollination is essential for maximum fruit set and minimizing adverse interaction between bees, humans and livestock. Beekeepers and growers must exercise sound judgment in the transportation and placement of colonies paying particular attention to factors which are site specific. Fields located in populated areas require more caution in the handling and placement in contrast to the remote.

Both the beekeeper and grower must pay particular attention to areas that hold animals or livestock. Animals that are tied or penned are more vulnerable to mass stinging especially when the colony are initially moved in and unloaded or when extensively manipulated such as during honey removal.

When choosing the location of honey bee colonies the potential for adverse interaction with people and animals must outweigh convenience of the site. Usually, the grower is more familiar with local conditions than the beekeeper. This is especially the case with migratory beekeepers, who reside outside the state and often distribute hives during the night.

The spread of the Africanized honey bee in the U.S., will present both management and public relations challenges to America's beekeepers and growers. It is incumbent upon beekeepers, the agriculture community and government to project a positive image to the general public and the local community.

Timing of the placement of colonies into blooming fields is variable according to location. Large acreage benefit from early placement. Smaller fields are better pollinated when hives are placed at 10% bloom. With a delayed placement, honey bees fix on the crop rather than attractive pollen/nectar sources that compete.

Location of hives is important with respect to public relations and pollination efficiency. Sunny areas that are sheltered from the wind are the best apiary sites. Plenty of morning sun will aid in early foraging activities since less bees are required to maintain hive temperatures. Likewise, colonies sheltered from the wind have more foraging activity.

Honey Bee Etiquette

1)When transporting bee colonies on public roads always have the load netted or screen the entrances of hives.

2)Locate staging yards away from populated areas. Staging yards tend to have defensive bees.

3)Post fields containing bees for pollination. Certain individuals are highly allergic to bee stings and one sting can be life threatening.

4)Situate hives away from high traffic areas. Locate hives away from roads so the bees do not interfere with vehicular or pedestrian traffic.

5)Placement of hives near or on utility 'right of ways" is discouraged unless permission is granted (powerlines, pipelines, underground cables).

6)Avoid placing colonies near school's, recreation areas, picnic grounds or other locations which may result in adverse honey bee/public interactions.

7)Remove hives from pollination when bees are not flying(night, rainy weather) this is very important in development areas since returning bees are inclined to sting.

8)Provide clean water resources in apiaries that do not have natural supplies of water or in areas with residential pools. Bees can become a nuisance in search of water sources, especially during warm springs.

9)Request that your pollinator operate gentle bees and manage European bee stocks and consistent with the "National Plan" developed at the USDA/NASDA St.Louis, MO. workshop(1991).

The grower agrees to pay the beekeeper an additional $__15.00__ per hive for changes in hive placement during the contract duration unless such changes are agreed to as follows:_____.

f. Loss of bee colony populations due to application of farm chemicals in violation of this contract shall be reimbursed to the beekeeper at the rate of __$100.00 per hive__. Payment of said reimbursement shall be made no less than __14 days__ subsequent to the date of said application. Loss of bee colony population shall be defined as the death of 50% or more of the adult bees in a given hive as a direct result of the application.

g. The grower agrees to pay the Pollination Service Fee of $0.50 per hive, per set, required by Chapter *15.60.027* RCW in support of the Industry Apiary Program within the Washington State Department of Agriculture. The grower may pay the fee to Tura-Lura Apiaries, to be forwarded to the department as a separate check, or the grower may pay the fee directly by check mailed to the department.

3. ARBITRATION

If any problem arises between the parties involved in this contract that cannot be resolved, then the problem(s) shall be settled by arbitration. Each party will choose an arbitrator within ten days to act in their behalf; these two shall select a third by mutual consent and a decision agreed upon by any two of these arbitrators shall be binding. The cost of any arbitration shall be shared equally by grower and beekeeper.

4. TRANSFER

The terms of this contract are transferable only to legal successors of either party only in the event of death of either the beekeeper or grower before fulfillment of the contract.

5. addenda & MISC.

By evidence of the signatures below, the beekeeper and grower agree to fulfill all portions of the contract as written. Signature of a witness may also be included.

Grower: _____ _____
(Print) *(Signature)*

_____
(Address)

_____ _____
(Phone) *(Date)*

Beekeeper:: _____ _____
(Print) *(Signature)*

_____
(Address)

_____ _____
(Phone) *(Date)*

Witness: _____ _____
(Print) *(Signature)*

_____
(Address)

_____ _____
(Phone) *(Date)*

1. Beekeeper's Responsibilities

a. The beekeeper shall supply the grower with__2___ colonies of bees to be delivered to the _____ as specified below:
(crop: apple orchard, squash field,etc.)

Projected date of delivery:_____. Beekeeper wil notify grower at least __2__ days in advance of any change in projected delivery date.

Name of location:_____.

Directions to location:_____

Placement instructions:_____

b. The beekeeper will provide colonies with the following minimum standards:
A laying queen with __6___ frames of adult bees and ___5__ frames of brood.
The __2___ story colony will have adequate surplus honey or equivalent feed.
The beekeeper will maintain all colonies at the standards above for the entire contract duration.

The grower may request inspection of any colony after notifying the beekeeper__2___ days in advance.

c. The beekeeper will leave the bees on the crop until notified by grower at least __2___ days prior to desired removal date. Beekeeper will remove hives within __2___ days of notification date.

Projected date of removal:_____.

Total projected duration of placement:_____days.

d. The beekeeper will not be responsible for personal injury caused by unauthorized hive manipulation, abuse of hives or careless behavior in the immediate vacinity of the hives during the contract duration.

2. **grower's Responsibilities**

a. The grower shall provide a location for the colonies that is accessible to the beekeeper and associated vehicles whenever it is necessary to work with the bees, including access to locked property if hives are placed therein.

b. The grower shall provide a source of water for the bees, if none is available witin one-half mile from the colonies as follows:_____.

c. The grower agrees to inform the beekeeper within not less than _48_ hours if materials hazardous to bees are to be applied to the crop during the duration of the contract. The grower agrees to not apply the following pesticides/fungicides to the target crop for the duration of the contract or within __2__ days prior to the placement of the hives:__none specified_____.

d. The grower agrees to pay $_____ per colony per set for _____colonies of bees.
Total payment to the beekeeper shall be $___100.00_____.

Payment to the beekeeper shall be made as follows: $ _____ within ___days_
of hive delivery, with the balance due within _____days_ of hive removal
or as follows:_____

e. The grower agrees to pay the beekeeper an additional $__50.00__ per hive for each additional hive requested beyond the number of hives and after the dates of placement specified in this contract.

POLLINATION CONTRACT

This contract is made_____, 2005 between _____, the
(date) (beekeeper name)
beekeeper and _____, the grower for the ____ growing year.
(grower name)

F. Written pollination and land use contract

From the Apprentice Study Guide:

> Renting out hives for pollination is a specialized facet of beekeeping and another way to generate income. The same colonies ma be rented for several crops during the year. Caution: persons moving bees between crops need to be aware of any problems pertaining to pollination. Care needs to be taken to prevent cross pollination in hybrid varieties. And, hive need to be moved at least 3 to 5 miles when changing sites
>
> A common mistake that newcomers make when entering the pollination business is to set their prices too low. It is okay to put a hive in a friend's backyard to pollinate their apple tree, or to keep a few hives in an apiary on a farm in a mutual benefit arrangement. But to supply hives for pollination of a commercial crop at a low price is unfair to those beekeepers trying to make a living at pollination. It is also uneconomical when the aforementioned costs and hazards are taken into account. There is probably room for both commercial and non-commercial beekeepers in pollination. Most commercial beekeepers have their hives on pallets and use large trucks. They usually don't want to other with the small jobs requiring only a few hives. Non-commercial beekeepers could take these jobs, after checking to find out a fair price to charge.

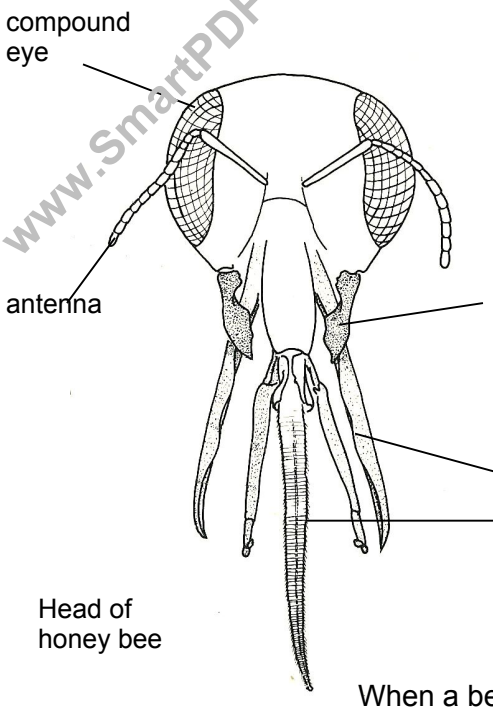
It is highly desirable for beekeepers and growers to have a written agreement when honey bee colonies are being rented for pollination services.
Such a contract will help to prevent misunderstandings and thus insure better pollination service. Key points that should be included in the contract are:
http://maarec.psu.edu/pdfs/Pollination_Contract.pdf

• Date of movement of bees into the crop, or the time relative to a certain condition of bloom, and the date on which bees are to be removed
• Location of crop
• Number and strength of colonies
• Pattern of colony placement
• Rental fee and the date(s) on which it is payable
• Grower agrees not to apply bee-toxic pesticides while bees are in the crop, but if necessary to do so, the beekeeper will be given 48 hours notice
• Grower agrees to warn beekeeper of other sprayings in the area
• Grower agrees to reimburse the beekeeper for any additional movement of colonies in, out, or around the crop
• Grower will provide right of entry to beekeeper for management of bees.

SEE SAMPLE POLLINATION CONTRACT BELOW:

Honey bee feeding

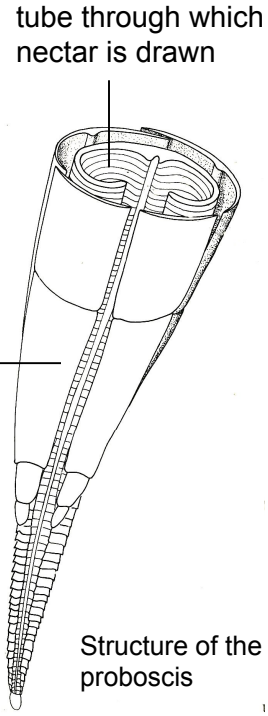
The honeybee feeds on nectar and pollen, both of which are collected from flowers



Head of honey bee

Nectar

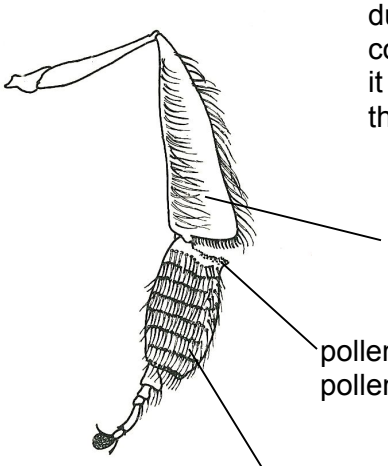
The nectar is sucked from the nectaries in flowers by means of a proboscis. The proboscis is tucked back under the thorax when not in use



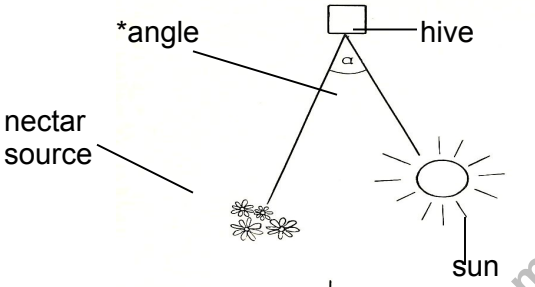
Structure of the proboscis

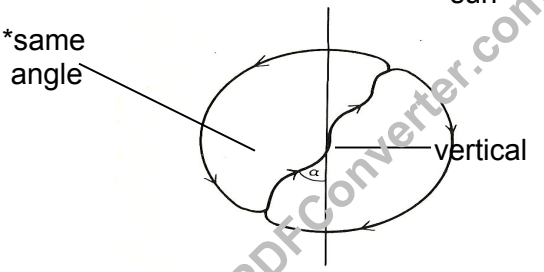
Pollen

When a bee visits a flower, its body becomes dusted with pollen. The hind legs are adapted to comb the pollen off the body, compact it and store it as 'pollen sacs'. These are pushed into cells in the hive when the bee returns.



Bee's hind leg





The waggle-tail dance

A bee returning to the hive from a good source of nectar performs a 'dance' on the vertical comb. The dance follows a track like a squashed figure 8. The angle between the central line and the vertical represents the angle between the source, the hive and the sun. The degree of 'waggle' in this line indicates the distance; more waggle means greater distance. Other workers, in the darkness of the hive follow the dancing bee and so learn the direction and distance of the nectar source

E. Honey Bee Foraging Bee-havior

Foraging http://en.wikipedia.org/wiki/Forage_(honey_bee)

As a rule of thumb the foraging area around a beehive extends for two miles (3 km), although bees have been observed foraging twice and three times this distance from the hive. Foraging at extreme distances wears out the wings of individual bees, reduces the life expectancy of foraging bees and therefore the efficiency of the colony. The minimum temperature for active honeybee foraging is approximately 55 °F (13 °C). Full foraging activity is not achieved until the temperature rises to 66 °F (19 °C). There are small differences in the races of the Western honey bees at what temperature they will start foraging.

The main nectar source and main pollen source differ widely with the latitude, region, season and type of vegetation. Bees are able to communicate direction and distance of a food source by means of the round dance, waggle dance and shaking signals.

In addition to nectar and pollen, honey bees may forage for a honeydew source in certain coniferous trees and on oaks.

Honeybee Foraging Behavioral Analysis http://en.wikibooks.org/wiki/Animal_Behavior/Honeybee_Foraging_Behavioral_Analysis

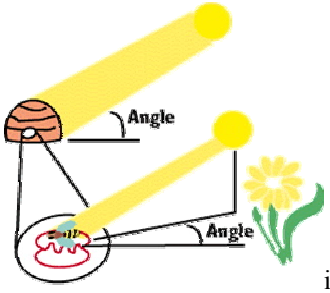
Several landmark studies were performed in the middle of the 20th century to analyze how these social organisms communicated exact distances and direction to one another in order to effectively locate these resources. Karl von Frisch determined that honeybees perform two distinct dance routines that coincide with two different distance approximations made by the foraging bee. These two dances, the Round dance and the Waggle dance, communicate to the other the approximate distance from the hive to the new resource. Only the Waggle dance communicates direction

Round dance

The Round dance is preformed by the returning bee usually in complete darkness, vertically on a honeycomb. The circuitous motion attracts other foragers, which then learn that the resource is within approximately 50 meters of the hive. No direction is given by this routine (von Frisch). As a result, the newest foragers leave to search in all directions surrounding the hive. Behaviorally, this dance is energetically favorable due to the short distances traveled. In contrast, the Waggle dance is energetically unfavorable to the individual, but beneficial to the hive.

Waggle dance

The Waggle dance is performed primarily when the resource is further than 50 meters. The returning forager either performs the dance on a vertical surface or a horizontal one. To determine distance and direction, the bee orientates itself relative to the sun. Any deviation from this point gives the angle the new foragers should pursue. If vertical, the bee orientates itself to gravity. Perpendicular to the ground becomes the reference point (i.e. the sun). Deviations from such relay direction accordingly. Distance is communicated by the length of the abdomen shake that forms the middle of a figure eight dance (von Frisch).



the dance information sent

http://bio.research.ucsc.edu/~barrylab/classes/old_animal_behavior/Dispersal_and_Migration.htm

D. Colonies Per Acre Per Crop

Number of Hives

The number of recommended hives per acre depends on the attractiveness of the crop to bees, number of wild bees, number of competing weeds, strength and location of bee hives, weather, and the grower's experience. Generally, anything that reduces pollination efficiency (unattractive crop, few wild bees, many competing weeds, poor weather, etc.) calls for more bee hives per acre to compensate. As a starting point, consider one hive per acre, and move up or down according to the advice of experienced growers, beekeepers, or your county Extension agent. The section on "Crop Pollination Requirements" gives more specific recommendations.

Spacing colonies

Proper hive placement has been shown to increase yields in some crops. During periods unfavorable to foraging, bees tend to work areas close to the hive. On meadowfoam sites greater than 10 acres, a minimum colony spacing of 30 hives every 10 acres should increase pollination and yields, although no data are available to verify this.

Timing

Introduction at 10 percent bloom will help to discourage colonies from initially foraging on competing plants, but if you delay introduction past 10 percent bloom, severe yield reductions may result.

You can begin removing honey bee hives from the field when less than 5 percent of the bloom remains.

http://en.wikipedia.org/wiki/Pollination_management

Common name	number of hives per acre
Alfalfa	1, (3-5) [2]
Almonds	2-3
Apples (normal size)	1
Apples (semi dwarf)	2
Apples (dwarf)	3
Apricots	1
Blueberries	3-4
Borage	0.6 - 1.0 [3]
Buckwheat	0.5 - 1 [3]
Canola	1
Canola (hybrid)	2.0 -2.5 [3]
Cantaloupes	2-4, (average 2.4) [4]
Clovers	1 - 2 [3]
Cranberries	3
Cucumbers	1-2, (average 2.1) [4]
Ginseng	1
Muskmelon	1-3 [5] (7.5 hives per hectare) [6]
Nectarines	1
Peaches	1
Pears	1
Plums	1
Pumpkins	1
Raspberries	0.7 - 1.3 [3]
Squash	1-3 [7]
Strawberries	1 - 3.5 [3]
Sunflower	1
Trefoil	0.6 - 1.5 [3]
Watermelon	1-3, (average 1.3} [4]
Zucchini	1

(5) Oregon B *grade* Orchard colony of bees for orchard pollination shall be one that fails to meet requirements for a standard orchard colony by not more than 25% on amount of bees and brood but does meet all other requirements of a standard orchard colony.

(6) To allow for variations incident to proper grading a tolerance of 10% shall be allowed on all defects other than diseases and queens.

From the apprentice study guide:

Strong colonies (8-12 frames of bees) are best for good fruit tee pollination. Two five-frame colonies, with the same total strength of a ten-frame one, will no pollinate as effectively as the stronger one. A ten-frame colony has a larger field force, flies at lover temperatures, better deals with minor diseases and resists attempts at being robbed. It is good beekeeping to equalize the strength of the colonies before the bloom and to concentrate on making them uniformly strong, which is especially important for pollination. The number of colonies required for pollination varies with the crop. Beekeepers in the pollination business should be familiar with Washington's minimum colony strength recommendations for the various tree fruit crops needing pollination in the state.

Pollination may be the key to the future of beekeepers in the United States. Since so many growers depend on honey bees for a good crop, they may be willing to help fund the research programs that are trying to find ways to increase the effectiveness of honey bees as pollinators and ways to protect honey bees from pesticides, diseases and parasites. With strong colonies and the proper equipment it should be possible to operate more hives, pollinate more crops, and produce less honey, yet have a larger net income than with honey production alone.

Washington

From Washington Department of Agriculture Apiary Regulations, Chapter 15.60, Order No. 1582 Effective October 27, 1978. WAC 16-602-030 Colony Strength.

The official minimum standard required for colony strength certification in the State of Washington shall be:

(1) A honeybee colony to be used in agricultural crop pollination shall have a laying queen (be "queen right").

(2) Colonies shall consist of at least six frames, two-thirds covered with bees at a temperature of 65°F for orchard, berry, seed, and legume pollination.

(3) Hives shall consist of frames of drawn comb

(4) The official minimum standards shall remain as stated…..continuously unless the director by his own motion or upon the advice of the apiary advisory board determines that a new standard may be needed

(5) The dpt. May conduct any requested inspections to determine colony strength against the official min. standards. .

Oregon

From Oregon administrative Rules, Chapter 603, Section 55-005, filed with the Secretary of State August 17, 1960, as Administrative Order AD 643.

55-005 BEES. (1) As used in this section:

(a) European foulbrood shall be deemed serious if 20 or more larvae are found dead from this disease and more than 20% of the cells in the capped brood area are vacant.

(b) A queen shall be deemed a normal laying queen if her eggs that are in the worker cells are producing worker bees as indicated by the brood present.

(2) Oregon *Standard* (or Grade A) Field colony of bees for pollination shall be one that meets the following requirements:

(a) Free from American foulbrood and not seriously infected with European foulbrood or other bee disease.

(b) 3,000 square inches of comb, 1,000 square inches of which shall be occupied by live brood.

(c) Bees to cover well all brood. There shall be enough bees to cover well 10 standard Hoffman frames of comb or their equivalent.

(d) 10 pounds of honey or its equivalent of suitable bee food other than pollen or pollen substitute.

(e) A normal laying queen present.

(3) Oregon B *grade* Field colony of bees for field crop pollination shall be one that fails to meet the requirements of a standard field colony on amount of bees and brood by not over 25% but does meet all other requirements of a standard field colony.

(4) Oregon *Standard* (or Grade A) Orchard colony of bees for orchard pollination purposes shall be one that meets the following requirements:

(a) Free from American foulbrood and not seriously infected with European foulbrood or other bee disease.

(b) 3,000 square inches of comb space of which 600 square inches shall be occupied by live brood.

(c) Bees to cover well all brood. Bees to cover well at least 6 standard Hoffman frames of comb or their equivalent.

(d) 10 pounds of honey or its equivalent in suitable bee food other than pollen or pollen substitute.

(e) A normal laying queen present.

C. Colony Strength

For Pollination Services http://www.hort.wisc.edu/cran/pubs_archive/proceedings/2004/Evalua ting%20bees.pdf

How strong should a colony be? A colony should contain *a minimum* of 9-10 frames of bees, and a maximum of 15-16, although a colony with 9-10 frames of bees is sufficient. To be more specific, one deep hive box (brood chamber) contains 9-10 frames. Most colonies are kept in 2 deep hive bodies, with honey supers (less deep boxes) on top.

A good frame of bees is *covered* with bees, both sides, top to bottom. If there are 10 frames of bees, there should be 6-8 frames of brood of all ages (eggs, larvae, and pupae). If there are 16 frames of bees, there will be 10-13 frames of brood. There should be a laying queen, noted by the presence of eggs in the combs. Lots of brood in the colony, especially larvae which require constant feeding, stimulates bees to collect pollen – this is an important thing for a grower to know.

Another important point is that the colonies should have empty supers where they can store honey. If the supers are full when they arrive, the bees will have no place to store honey and may swarm. Empty supers stimulate the bees to collect honey – another important fact for growers.

In sum, strong colonies with good, laying queens and room to store honey will be the best pollinators of cranberries. After 2-3 weeks in the cranberry fields, the beekeeper will want to move the bees to a different location where they can build back up and produce more honey.

The strength of the colonies a grower rents will be influenced by several factors:
http://extension.oregonstate.edu/catalog/html/pnw/pnw245/

1. *The time of year.* The earlier a crop blooms in the season, the greater the likelihood that the colonies wil not be as large as the same colonies rented later in the season to pollinate another crop.
2. *Management of the colonies.* Beekeepers can speed up or slow down the natural growth of their hives with a variety of techniques. Colonies provided with supplemental food such as sugar syrup and/or pollen supplement early in the season will be stimulated to grow more rapidly. Colonies taken to California in December or January (primarily for almond pollination) will begin foraging earlier. Later on, they will be stronger than colonies left in the Pacific Northwest.

   When the beekeeper brings such colonies back to our area, they will be in better condition for early season pollination service. When beekeepers consider colonies overly strong early in the year, they often divide them or split them into several colonies, adding new queens to the new colonies. This is the method most beekeepers use to increase their colony numbers.

3. *Weight and size.* For commercial beekeepers--who often manage several thousand colonies--practical considerations (such as the number of hives
   they can haul on a given truck) are of prime importance.

   Commercial beekeeping is migratory in nature, and the seasonal movement of colonies covers thousands of miles. ease with which beekeepers load
   colonies on and off their and place them into fields orchards often dictates the maximum size of the colonies rent.

Colony-strength regulations

The Oregon and Washington Departments of Agriculture have mandatory colony-strength regulations for hives involved in commercial pollination of agricultural crops within their states. Idaho does not have such regulations.

The regulations are designed to assure growers that colonies they rent will meet minimum biological standards.

Nectar corridors

Migratory pollinators require a continuous supply of nectar sources to gain their energy requirements for the migration. In some areas development or agriculture has disrupted and broken up these traditional corridors, and the pollinators have to find alternative routes or discontinue migration. A good example is the endangered lesser long-nosed bat (Leptonycteris curasoae) which was formerly the main pollinator of a number of cactus species in southwestern United States. Its numbers have severely declined, in part due to disruption of the nectar corridors that it formerly followed. Other migratory pollinators include monarch butterflies and some hummingbirds.

Hive destruction

Bees are often viewed negatively by homeowners and other property owners. A search for "carpenter bees" on the Internet primarily yields information on removal rather than information regarding bees in a positive light. Recent hysteria regarding killer bees has contributed to these views. Beekeepers find increased vandalism of their hives, more difficulty in finding locations for bee yards, and more people inclined to sue the local beekeeper if they are stung, even if it is by a yellw jacket.

Threat by invasive honey bees

Many native pollinators decline in population when faced with competition from invasive honey bees. For example, the western honey bee is invasive in the United States, the wild population comprised entirely of feral bees escaped from European bee colonies imported to fertilize non-native, old-world crops. Where colony collapse disorder reduced invasive honey bee populations in the US, native pollinators sometimes have made recoveries, restored to their natural niche by the loss.

Air pollution

Researchers at the University of Virginia have discovered that air pollution from automobiles and power plants has been inhibiting the ability of pollinators such as bees and butterflies to find the fragrances of flowers. Pollutants such as ozone, hydroxyl, and nitrate radicals bond quickly with volatile scent molecules of flowers, which consequently travel shorter distances intact. There results a vicious cycle in which pollinators travel increasingly longer distances to find flowers providing them nectar, and flowers receive inadequate pollination to reproduce and diversify.

B. Environmental Difficulties

(from the Apprentice Study guide) :

Most beekeepers are not aware of the costs involved in moving bees. In addition to the labor and the cost of operating a truck, there is a loss of honey (as much as one shallow super per colony). Also, there are hazards, which include loss of queens (about 5%), an occasional colony lost to suffocation in transit, possible exposure to pesticides and vandalism, and the dangers of increased incidences of disease, robbing, and drifting. Other risks are flooding and liability suits for bee stings.

Pollinator Decline *http://en.wikipedia.org/wiki/Pollinator_decline*

The term **Pollinator decline** refers to the reduction in abundance of pollinators in many ecosystems worldwide during the end of the twentieth century.

Pollinators participate in sexual reproduction of many plants, by ensuring cross-pollination, essential for some species, or a major factor in ensuring genetic diversity for others. Since plants are the primary food source for animals, the reduction of one of the primary pollination agents, or even their possible disappearance, has raised concern, and the conservation of pollinators has become part of biodiversity conservation efforts.

Possible explanations for pollinator decline

Pesticide misuse

It is a label violation to apply most insecticides on crops during bloom, or to allow the pesticide to drift to blooming weeds that bees are visiting. Yet such applications are frequently done, with little enforcement of the bee protection directions. Pesticide misuse has driven beekeepers out of business, but can affect native wild bees even more, because they have no human to move or protect them.

Widespread aerial applications for mosquitoes, med-flies, grasshoppers, gypsy moths and other insects leave no islands of safety where wild insect pollinators can reproduce and repopulate. One such program can reduce or endanger pollinator populations for several years.

Many homeowners feel that dandelions and clover are weeds, that lawns should only be grass, and that they should be highly treated with pesticides. This makes a hostile environment for bees, butterflies and other pollinators.

See articles: Endangered arthropod Imidacloprid effects on bee population Regent

Rapid transfer of parasites and diseases of pollinator species around the world

Increased international commerce within modern times has moved diseases such as American foulbrood and chalkbrood, and parasites such as varroa mites, acarina mites, and the small African hive beetle to new areas of the world, causing much loss of bees in the areas where they do not have much resistance to these pests. Imported fire ants have decimated ground nesting bees in wide areas of the southern US.

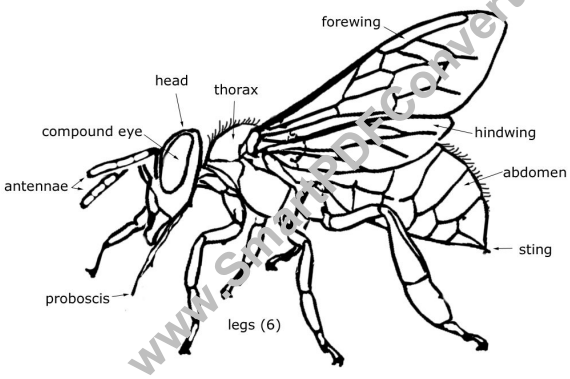
Loss of habitat and forage

The push to remove hedgerows and other "unproductive" land in some farm areas removes habitat and homes for wild bees. Large tractor mounted rotary mowers may make farms and roadsides look neater, but they remove bee habitat at the same time. Old crops such as sweet clover and buckwheat, which were very good for bees have been disappearing. Urban and suburban development pave or build over former areas of pollinator habitat.

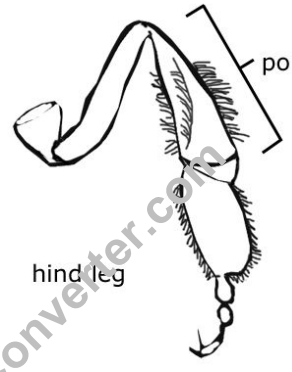
Clearcut logging, especially when mixed forests are replaced by uniform age pine planting, causes serious loss of pollinators, by removing hardwood bloom that feeds bees early in the season, and by removing hollow trees used by feral honey bees, and dead stubs used by many solitary bees.

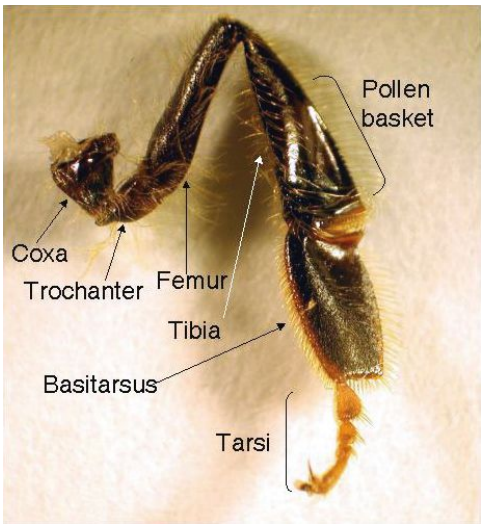
Why are honey bees such efficient pollinators?

1. Their bodies are covered with fine hairs that trap pollen
2. Their body shape and long proboscis allows them to reach deep into flowers.
3. They require a lot of nectar and pollen to rear their young, thus they visit numerous flowers.
4. They tend to visit one species of flower at time.

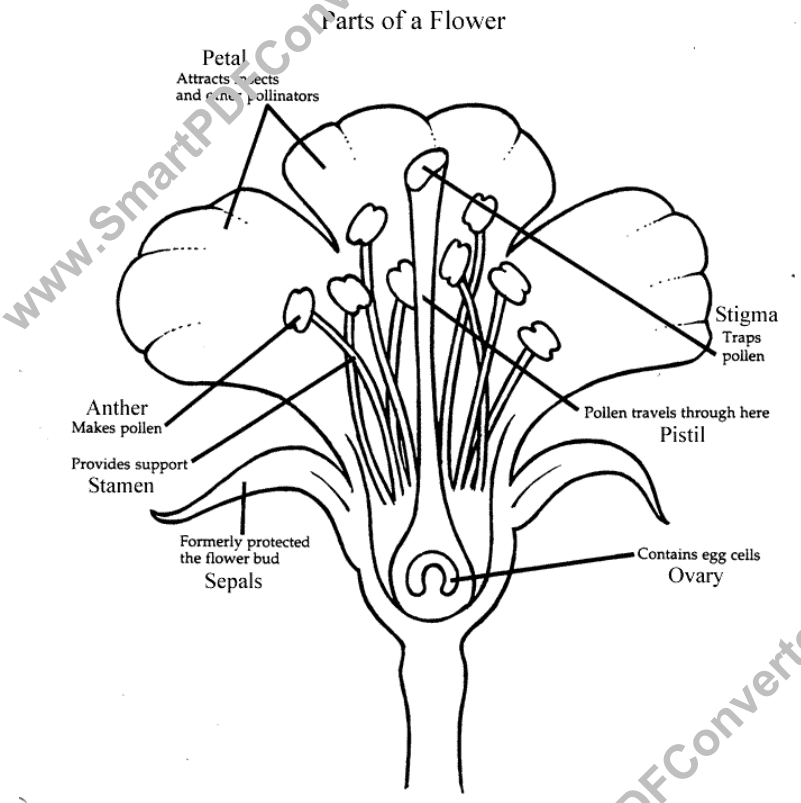


The pollen basket is a concave area on the hind legs surrounded by rows of stiff hairs. The bee packs moist pollen in there for transport back to the hive.





POLLINATION PICTURES:



http://www.learner.org/jnorth/images/graphics/t/flower_parts.gif

Biotic pollination

More commonly, the process of pollination requires pollinators: organisms that carry or move the pollen grains from the anther to the receptive part of the carpel or pistil. This is **biotic pollination**. The various flower traits (and combinations thereof) that differentially attract one type of pollinator or another are known as pollination syndromes.

There are roughly 200,000 varieties of animal pollinators in the wild, most of which are insects.[2] **Entomophily**, pollination by insects, often occurs on plants that have developed colored petals and a strong scent to attract insects such as, bees, wasps and occasionally ants (Hymenoptera), beetles (Coleoptera), moths and butterflies (Lepidoptera), and flies (Diptera). In **Zoophily**, pollination is done by vertebrates such as birds and bats, particularly, hummingbirds, sunbirds, spiderhunters, honeyeaters, and fruit Bats. Plants adapted to using bats or moths as pollinators typically have white petals and a strong scent, while plants that use birds as pollinators tend to develop red petals and rarely develop a scent (few birds have a sense of smell).

Mechanics

Pollination also requires consideration of pollenizers. The terms "pollinator" and "pollenizer" are often confused: a **pollinator** is the agent that moves the pollen, whether it be bees, flies, bats, moths, or birds; a **pollenizer** is the plant that serves as the pollen source for other plants. Some plants are **self-fertile** or **self-compatible** and can pollinate themselves (e.g., they act as their own pollenizer). Other plants have chemical or physical barriers to self-pollination and need to be cross-pollinated: with these self-infertile plants, not only pollinators must be considered but pollenizers as well. In pollination management, a good pollenizer is a plant that provides compatible, viable and plentiful pollen and blooms at the same time as the plant that is to be pollinated.

Pollination can be **cross-pollination** with a pollinator and an external pollenizer, **self-pollenization** with a pollinator, or **self-pollination** without any pollinator:

- Cross-pollination (***syngamy***): pollen is delivered to a flower of a different plant. Plants adapted to outcross or cross-pollinise have taller stamens than carpels to better spread pollen to other flowers.
- Self-pollenization (***autogamy***): pollen moves to the female part of the same flower, or to another flower on the same individual plant. This is sometimes referred to as self-pollination, but this is not synonymous with autogamy. Clarity requires that the term "self-pollination" be restricted to those plants that accomplish pollination without an external pollinator (example: the stamens actually grow into contact with the pistil to transfer the pollen). Most peach varieties are autogamous, but not truly self-pollinated, as it is generally an insect pollinator that moves the pollen from anther to stigma. Plants adapted to self-fertilize have similar stamen and carpel length.
- ***Cleistogamy***: is self-pollination that occurs before the flower opens. The pollen is released from the anther within the flower or the pollen on the anther grows a tube down the style to the ovules. It is a type of sexual breeding, in contrast to asexual systems such as apomixis. Some *cleistogamous* flowers never open, in contrast to ***chasmogamous*** flowers that open and are then pollinated. Cleistogamous flowers by necessity are self-compatible or self-fertile plants.[3] Many plants are self-incompatible, and these two conditions are end points on a continuum.

How do bees pollinate plants?

As bees travel from blossom to blossom in search of nectar, they brush against the pollen-bearing parts of a flower (anther or stamen) and pick up pollen. When the honey bee goes to another flower for more food, some of the pollen from the first flower sticks to the second flower. In this way, the flowers are pollinated.

ADDITIONAL INFORMATION:
National Honey Board /Pollination Brochure http://www.honey.com/downloads/pollination_brochure.pdf
Pollination Beekeepers http://www.pollinator.com/

SECTION 3
POLLINATION

A. Definition of pollination

DEFINITION: Flower pollination & crop pollination

FLOWER POLLINATION (from the Apprentice Study guide)

Pollination is the transfer of pollen from anthers (male parts) to stigmas (female parts), either on the same flower, different flowers of the same plant, or flowers on different plants. Self-fertile plants can be pollinated from the same variety of plant, but many fruits require cross-pollination, where the pollen of one variety must be carried to the stigma of another variety. Sometimes, as in holly and willow trees, the male flowers are on one plant and the females are on another plant.

CROP POLENATION (from the Apprentice Study guide)

Many farm crops are either dependent on insects for pollination, more abundant yield, or improvement in quality of crops when insects are plentiful. These crops include most fruits and berries, some of the nuts, many legumes (clover, alfalfa, vetch, and trefoil), melons, cucumbers, and many other vegetables. Populations of wild pollinators, including feral honey bees, are dropping due to changes in the nature of farming and elimination of nesting places for these insects. Farms are getting larger, especially those specializing in fruits, vegetables, and seed production. The importance of honey bees as pollinators is increasing because colonies can be moved (in large numbers) in and out of crop as needed.
It is estimated that honey bees do 80% or more of the pollination of fruit and see crops in the United States.

In Agriculture

Pollination management is a branch of agriculture that seeks to protect and enhance present pollinators and often involves the culture and addition of pollinators in monoculture situations, such as commercial fruit orchards. The largest managed pollination event in the world is in Californian almond orchards, where nearly half (about one million hives) of the US honey bees are trucked to the almond orchards each spring. New York's apple crop requires about 30,000 hives; Maine's blueberry crop uses about 50,000 hives each year.

Bees are also brought to commercial plantings of cucumbers, squash, melons, strawberries, and many other crops. Honey bees are not the only managed pollinators: a few other species of bees are also raised as pollinators. The alfalfa leafcutter bee is an important pollinator for alfalfa seed in western United States and Canada. Bumblebees are increasingly raised and used extensively for greenhouse tomatoes and other crops.

TYPES OF PLANT POLLENATION

Abiotic pollination *http://en.wikipedia.org/wiki/Pollination*

Abiotic pollination refers to situations where pollination is mediated without the involvement of other organisms. Only 10% of flowering plants are pollinated without animal assistance.[2] The most common form, anemophily, is pollination by wind. This form of pollination is predominant in grasses, most conifers, and many deciduous trees. Hydrophily is pollination by water and occurs in aquatic plants which release their pollen directly into the surrounding water. About 80% of all plant pollination is biotic. Of the 20% of abiotically pollinated species, 98% is by wind and 2% by water.