THE HEALTH OF OUR HONEY BEES AND OUR BEEKEEPING INDUSTRY

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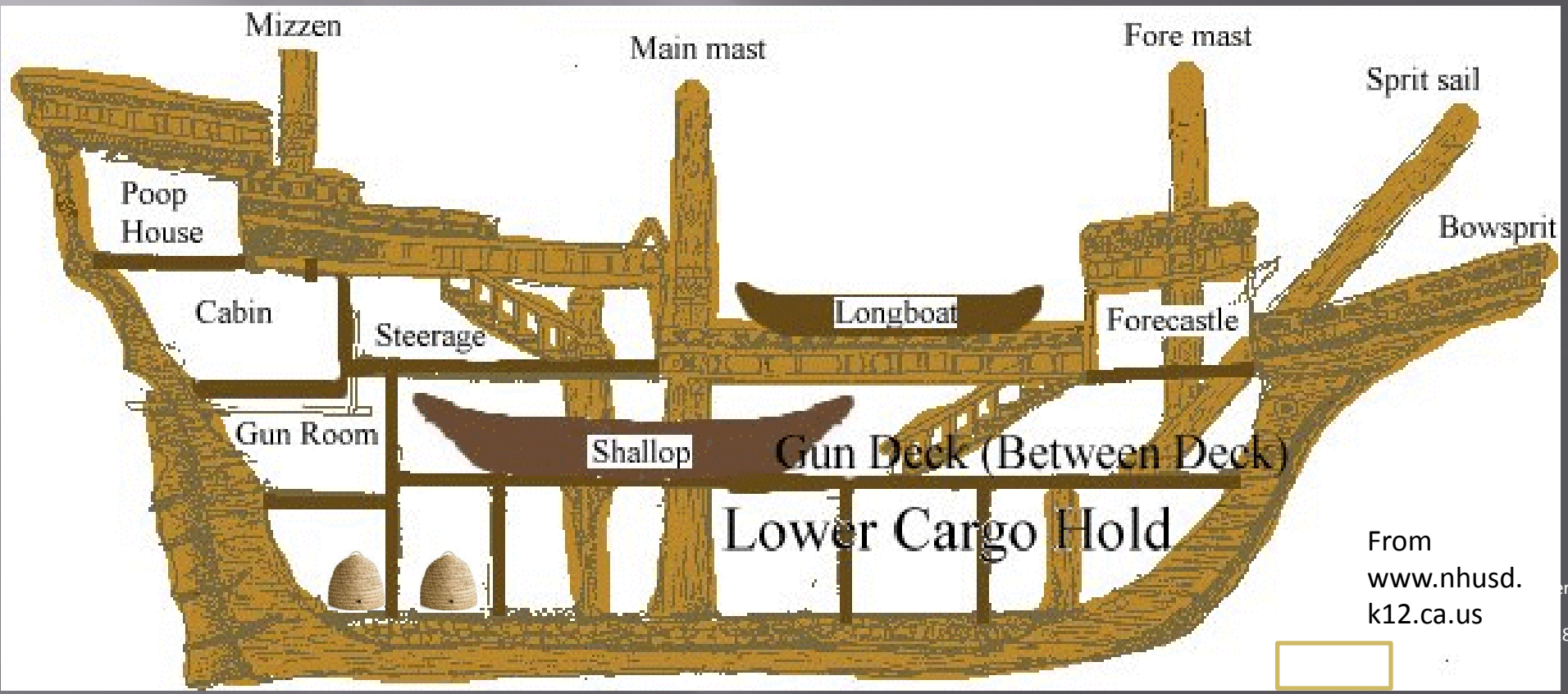
Topics to be Covered

- Historical look at the US beekeeping industry
- Factors believed to be associated with current colony losses
  - Malnutrition
  - Long distance transportation
  - Old and new bee diseases
  - Exotic mites
  - Frequent exposures to pesticides
- How people can help the bees

History of Honey Bees in the U.S.

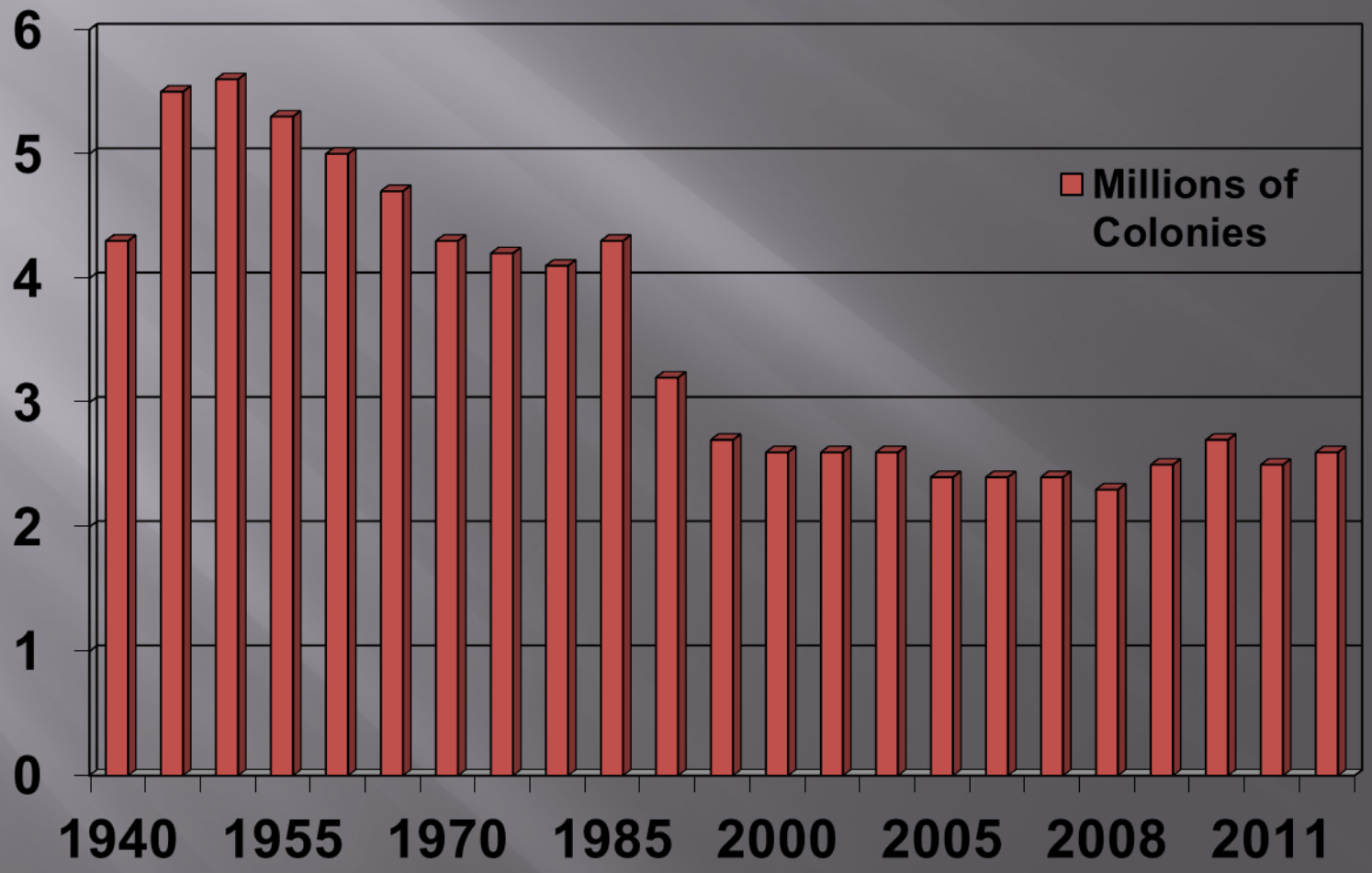
- Honey bees were successfully introduce into Virginia in 1622 (imports prohibited since 1922)



From www.nhusd.k12.ca.us

Honey Bee Colonies Introduced into California in 1853
Commemorative plaque at San Jose Airport

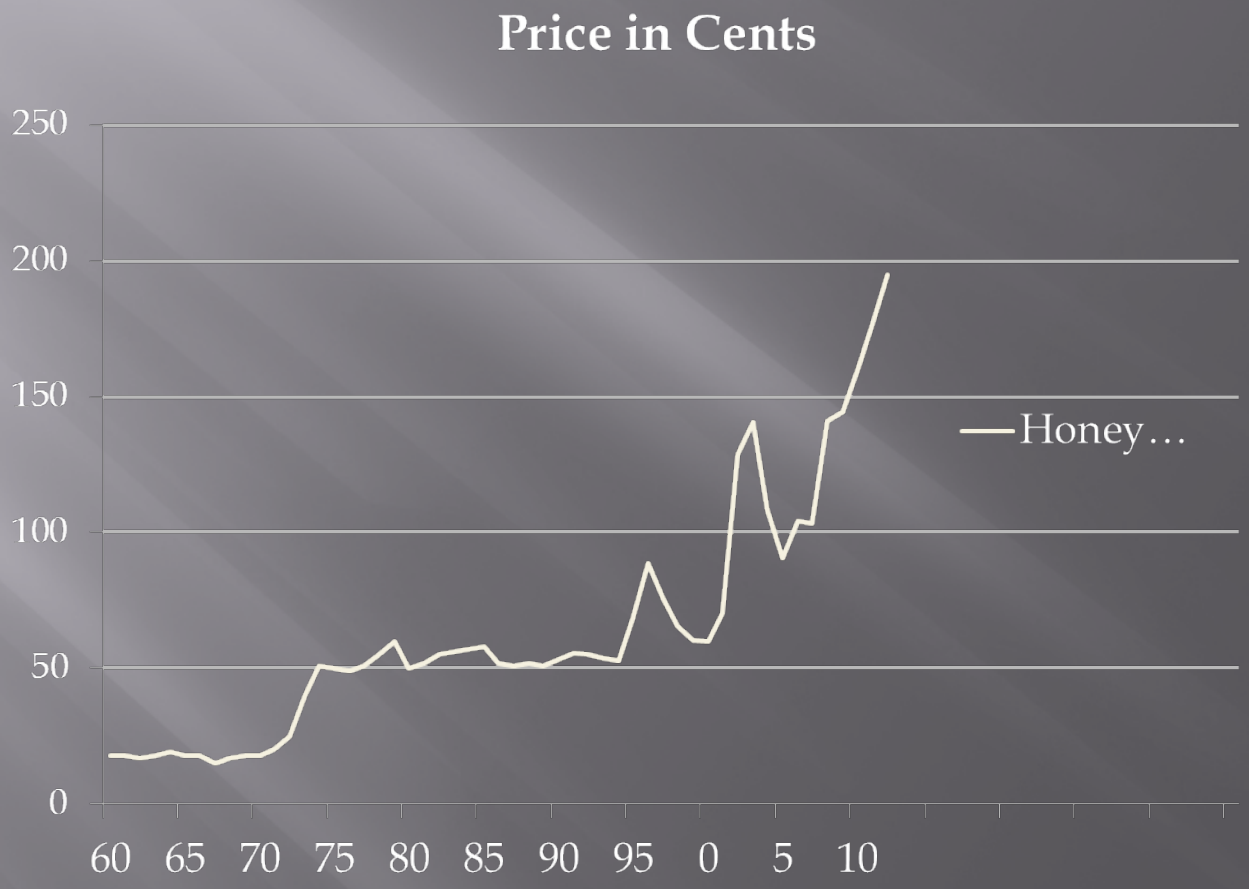
Number of U.S. Bee Colonies



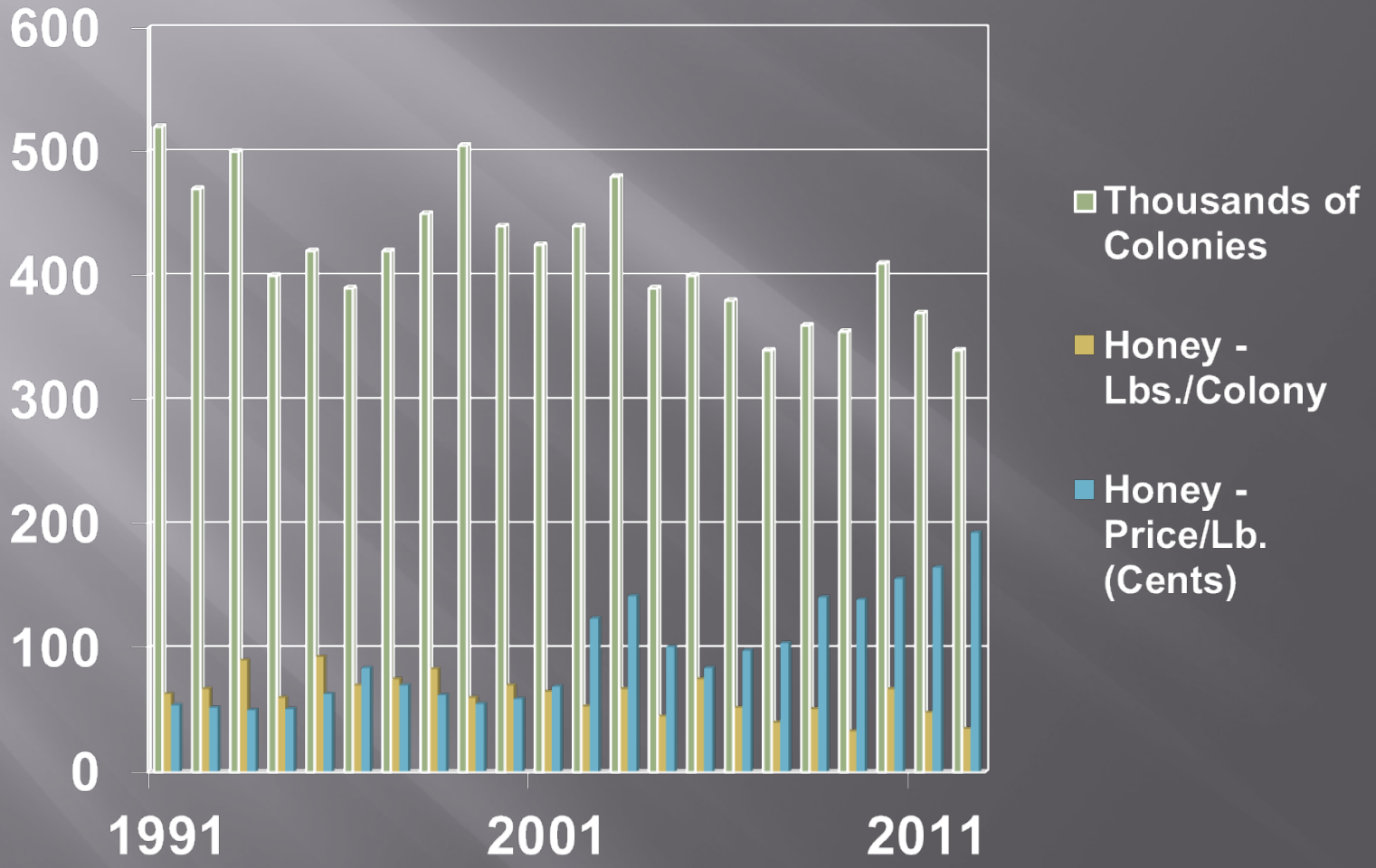
Colony Number Reductions

- Numbers of family farms diminished rapidly
  - Farmers kept most of the bees
- Sugar subsidies for beekeeping ended after WW II
- Income from a pound of honey not much higher than cost of production
  - Continued that way until just a few years ago, for many reasons

U.S. Average Honey Price to Producer



CA Honey Bee Statistics



Big Changes around the 1950s

- Field studies determined that honey bee pollination increase crop yields significantly
- Antibiotics were first used to treat honey bee diseases
- Average annual colony loss around 5-10 percent
  - Often due to increased use of pesticides on crops
  - Losses covered by “splitting” or “dividing” strongest colonies the next spring

Big Changes Around the 1950s

- Production and sales of queen and packaged bees evolves into big business
- “Bee Breeders” select from their best stocks
- One-day-old larvae are grafted into queen cells
- Queens reared in hives away from colony queens
- Queens mated in large mating yards – bees held in “mating nucs”
- Queens combined with bulk bees and sold as packages

Rearing Queen Honey Bees

- One-day-old larvae are “grafted” from breeder queens

New Queen Cells are Reared in Queenless Colonies

Photo from Zia Queens

Queen Cells are Moved into "Mating Nuclei" (200 + nucs in this field)

Photo from bickerstaffs-queen.blogspot.com

Two Pounds of Bulk Bees and a Mated Queen Surrounding Can of Sugar Syrup

Installing a Package

Honey Bee Epizootics

- Occurred occasionally from late 1800s to present
  - Generally a one-year phenomenon
- 1963-1965
  - Description just like CCD (colony collapse disorder)
- Current CCD
  - Recognized in 2000, but began to have major economic consequences in 2004
  - Named, and became a media darling, in 2006

Honey Bee Mites

- Exotic mites moved into our colonies
  - 1984
    - Tracheal mites (*Acarapis woodi*)
    - Apparently from Europe
    - In five years spread across the country killing about 50% of our colonies
  - 1987
    - Varroa mites (*Varroa destructor*)
    - Original host species were Asian honey bees
    - In five years spread across the country killing about 50% of our colonies

Honey Bee Mites

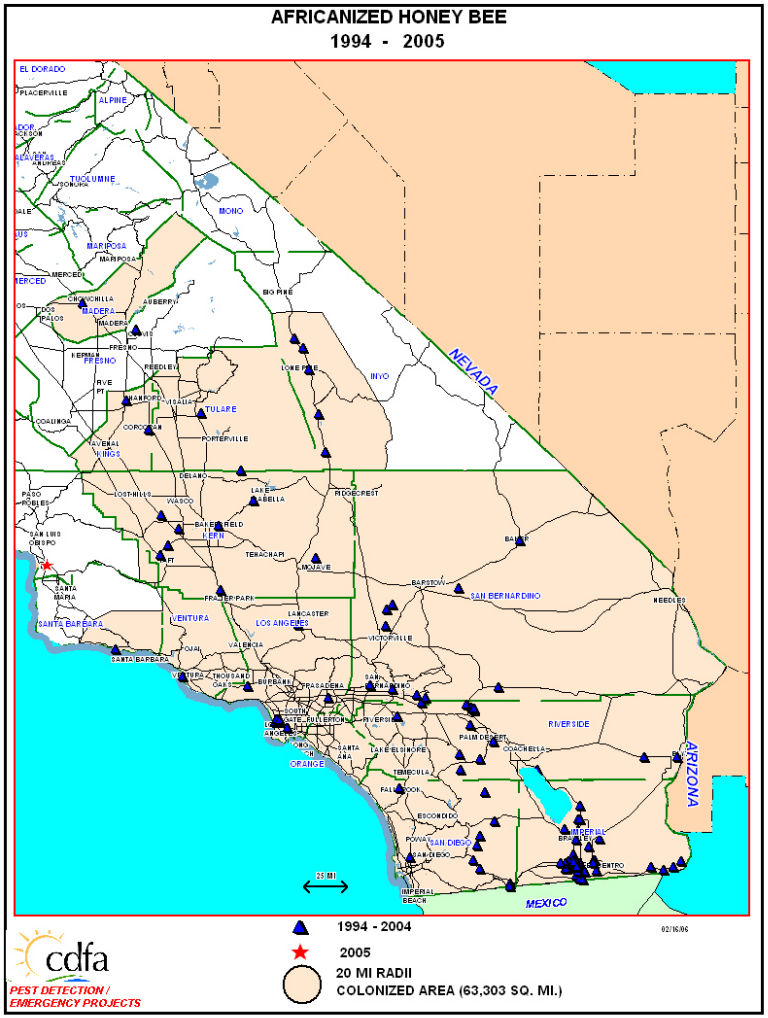
- Tracheal mites no longer seem to be much of a problem
- Varroa mites are the #1 problem around much of the northern hemisphere
  - Practically eliminated all feral U.S. honey bee colonies in 1995-1996
  - *Varroa* feeding suppresses the honey bee immune system and vectors most bee diseases
- Mites increased annual expected colony losses to 15-20%
  - As much loss as a beekeeping operation can tolerate

Honey Bee Mites

- Beginning with tracheal mites, and currently with varroa mites, beekeepers put pesticides into their hives on purpose
- The mites were controlled, but the colonies began to suffer
  - The first indication of problems was significant losses of queens beginning in 1990
    - At first blamed on queen breeders (unfounded)
    - Then blamed on the mites
    - Finally conceded it could be due to their acaricide use

Arrival of Africanized Honey Bees

- 1990 – southern tip of Texas
- 1994 – southeastern California



In Depth Look at CCD

- What happens?
  - Basically, all the adult bees fly away over a few days
  - Only the queen and a handful of newly emerged adults remain
  - Brood is abandoned in all stages of growth
  - Honey and stored pollen often are abundant
  - No dead adult bees are seen inside the hive or on the ground in front of the hive
- Beginning in 2004 annual colony deaths increased to over 30% and have stayed there for eight years
  - We claimed that was unsustainable, however the beekeepers are still there (but, for how much longer?)

Favorite Stated Causes of CCD

- Electromagnetic forces
  - Cell phone towers (actually microwaves)
  - Government radar installations
  - Not demonstrated by any well-conceived studies
- GMOs, particularly Monsanto's and Syngenta's crop plants
  - One type of corn pollen was found to be toxic to monarch butterfly caterpillars and taken off the market
  - Honey bee colonies fed the pollens showed no effects

Favorite Stated Causes of CCD

- Long distance transportation
  - Honey bees have been floated up and down the Nile River since the beginning of recorded time
  - Honey bees rode in horse-drawn wagons over rutty roads and in trailers behind Model T's

More Likely Causes of CCD

- Malnutrition
  - Honey bee colonies require an acre-equivalent of bloom, daily, to meet their nutritional needs
  - Honey bees fly up to four miles from the hive, providing them with 50 square miles in which to find food and water
  - Honey plants and other valuable foraging plants have been replaced by buildings, roads, parking lots, airports, commercial agricultural acres, and extensive use of herbicides

How Much Bee Forage Might Have Been There?

www.siteselection.com

More Likely Causes

- Bee Diseases
  - Bacterial – American and European foulbrood
    - AFB is lethal to brood and eventually to the colony
    - Highly transmissible
    - Prevented and treated with antibiotics
  - Fungal – chalkbrood and *Nosema* species
    - The larval disease, chalkbrood, is best resolved by replacing the queen from a more resistant stock
  - *Nosema apis* (from WAY back) is susceptible to fumagillin
  - *Nosema ceranae* (recent introduction from Asian bees) rebounds from fumagillin treatments by producing many more infectious spores

More Likely Causes

- Virus diseases
  - Honey bees have 22 named RNA virus diseases
  - Apparently, all of them can be vectored by varroa mites
  - Virus titers vary somewhat predictably from season to season
    - Some kill bees rather slowly; some quite quickly
    - Deformed wing virus' impact is pretty easy to see
    - Generally, CCD bees contain *Nosema ceranae* and one or more high level virus infections when they die
  - Exposing adult honey bees to essential oils in the hive seems to suppress virus titers to some extent

More Likely Causes

- Deformed wings also can be the result of eating pollen from California buckeye trees or being fed the fungicide captan

Photo by Dr. Ingemar Fries

More Likely Causes

- Exposure to Pesticides
  - No pesticides are harmless to honey bees
    - If nothing else, they use up valuable physiological energy just being detoxified
    - Because they are designed to kill something, they may kill bees if the pest and bee have the same target bichemical system
  - Honey bee exposure to pesticide residues is enormous
    - More than 150 residues of various products have been found in adult bee, beeswax, and stored pollen samples

More Likely Causes

- No individual pesticide, or family of pesticides, has been directly correlated with honey bee colony losses
- Although the neonicotinoids are the most widely used insecticides in the country, they hardly ever are found in dying bees or hive products
- Pesticides are just one of the stresses that combine to put a honey bee colony out of business

What Can We Do to Help Bees?

- Plant bee-attractive flowers, shrubs, and trees that bloom in late summer and fall
  - Honey bees need that added nutrition to produce healthy, long-lived, “winter bees”
- Minimize the use of pesticides around plant bloom
  - Choose products that claim to be safe around pollinators
    - Those labels reflect acute toxicity to adult bees, but not chronic, sublethal effects to brood and bees

What Can We Do to Help Bees?

- Apply pesticides when there is no pollen to contaminate in the blossoms
  - Normally, pollen is shed in the morning
  - With many bees around, it is gone by afternoon
    - Check for powder on the blossoms and big pollen loads on the bees' legs
  - When the pollen and pollen-collecting bees are gone, make the application
    - May have to wait until after sunset

What Can We Do to Help Bees?

- Choose pesticides that are less destructive to honey bees
- Brand new 35-page publication on this topic has just been released (free PDF download)
  - "How to Reduce Bee Poisoning from Pesticides" by L. Hooven, R. Sagili, and E. Johansen PNW 591 (2013) has excellent general information, then agricultural chemicals are listed by active ingredient and listed by product name, as well as their persistence in the field

http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/42829/PNW%20591.pdf (all one string)

How to Reduce Bee Poisoning from pesticides

L. Hooven
R. Sagili
E. Johansen

Photo: Ramesh Sagili

A PACIFIC NORTHWEST EXTENSION PUBLICATION • PNW 591
Oregon State University ■ University of Idaho ■ Washington State University

Table 4. Active ingredients of commonly used pesticides and their effect on bees in California, Idaho, Oregon, and Washington

Active Ingredient	Highly Toxic to Bees (RT)	Toxic to Bees (RT)	No Bee Precautionary Statement (PS) on Label	Common Product Names	Notes and Special Precautions
Abamectin (Avermectin) *Fermentation products derived from soil bacterium, affects nerve and muscle action of insects and mites*	X 0.025 lb ai/acre 1-3 days ERT , ≤ 0.025 lb ai/acre 8 hours RT [1] *Can vary with formulation and application rate*			Abacide, Abacus, Abba, Agmectin, Agri-Mek, Ardent, Avert, Avicta, Avid, Epi-Mek, Reaper, Solera, Solero, Temprano, Timectin, Zoro	ERT to bumble bees [2], short RT to alfalfa leafcutting bees and alkali bees at 0.025 lb ai/acre [1].
Acephate *Organophosphate insecticide*	X >3 days ERT [1] *Can vary with formulation and application rate*			Bracket, Orthene, Orthonex	Incompatible with bumble bees [2], ERT to alfalfa leafcutting bees and alkali bees [1].
Acequinocyl *Quinolone insecticide/miticide, metabolic poison*			X	Kanemite, Shuttle	
Acetamiprid *Neonicotinoid insecticide (cyano group)*		X Yes		Assail, Tristar, Transport	Length of residual toxicity to honey bees is unknown. ERT to alfalfa leafcutting bees and alkali bees [3]. 2 day ERT to bumble bees [2]. Cyano group neonicotinoids exhibit lower toxicity to bees than nitro group neonicotinoids [4].
Aldicarb *Systemic carbamate insecticide and nematicide*	X			Temik Only available as granular formulation [5]	Not hazardous to bees when applied at least 4 weeks prior to bloom [1]. May be a persistent contaminant of beeswax [6].
Alpha-cypermethrin *Pyrethroid insecticide*	X Yes			Fastac	Length of residual toxicity to bees unknown.
Aluminum tris O-ethyl phosphonate *Systemic organophosphate fungicide*			X	Aliette, Fosetyl-Al, Chipco, Flanker, Linebacker, Legion	
Azadirachtin *Insecticidal extract of neem oil Ecdysone antagonist*		X <2 hours RT [1] *Can vary with formulation and application rate*		Neemix, Amazin, Azera, Aza, Ecozin, Ornazin	Must be ingested to be toxic [7].
Azinphos-methyl *Organophosphate insecticide*	X 4 days ERT [1] 5 days ERT [8] *Can vary with formulation and application rate*			Guthion *is being phased out*	ERT to alfalfa leafcutting bees and alkali bees [1].
Azoxystrobin *ß-methoxyacrylate fungicide*			X	Abound, Dynasty, Heritage, Quadris	
Bacillus subtilis *Fungicide derived from naturally occurring soil bacterium*			X	Kodiak, Rhapsody, Serenade, Optiva, Companion, Cease	Laboratory tests suggest potential effects on bumble bees [9].

Table 5. Trade names of commonly used pesticides and their active ingredients* in California, Idaho, Oregon, and Washington

Trade name	Active ingredient
Abacide	abamectin (avermectin)
Abacus	abamectin (avermectin)
Abba	abamectin (avermectin)
Abound	azoxystrobin
Acaritouch	propylene glycol monolaurate
Acelepryn	chlorantraniliprole
Acramite	bifenazate
Actara	thiamethoxam
Actino-Iron	*Streptomyces lydicus*
Actinovate	*Streptomyces lydicus*
Adage	thiamethoxam
Adament	tebuconazole
Admire	imidacloprid
Adorn	fluopicolide
Agmectin	abamectin (avermectin)
Agree	*Bacillus thuringiensis*
Agri-Flex	abamectin (avermectin) and thiamethoxam
Agri-Mek	abamectin (avermectin)
Akari	fenpyroximate
Alias	imidacloprid
Aliette	aluminum tris o-ethyl phosphonate
Allegiance	metalaxyl
Altacor	chlorantraniliprole
Amazin	azadirachtin
Ambush	permethrin
Amtide	tebuconazole
Apollo	clofentezine
Applaud	buprofezin
Apron	mefenoxam
Acquire	metalaxyl
Ardent	abamectin (avermectin)
Arena	clothianidin
Armada	triadimefon
Armicarb	potassium bicarbonate
Asana	esfenvalerate
Assail	acetamiprid
Assurity	spinetoram
Avaunt	indoxacarb
Avert	abamectin (avermectin)
Avicta	abamectin (avermectin)
Avid	abamectin (avermectin)
Aza	azadirachtin
Badge	copper hydroxide
Banner Maxx	propiconazole
Batallion	deltamethrin
Baythroid	beta-cyfluthrin (cyfluthrin)
Baythroid	cyfluthrin
Bee Gone	permethrin
Beethoven	etoxazole
Belay	clothianidin
Beleaf	flonicamid
Belmont	metalaxyl
Belt	flubendiamide
Benefit	imidacloprid
Biocover	petroleum/paraffinic oil
Bolton	gamma-cyhalothrin
Borax	sodium tetraborohydrate decahydrate
Bordeaux Mixture	copper sulfate + lime
Botaniguard	*Beauveria bassiana*
Botran	Dichloran
Bracket	acephate
Bravo	chlorothalonil
Brigade	bifenthrin
Brigadier	imidacloprid
BT	*Bacillus thuringiensis*
Bull's Eye	spinosad
Bumper	propiconazole
Buzz Ultra	tebuconazole
Cabrio	pyraclostrobin
Calypso	thiacloprid
Captan	captan
Captec	captan
Captevate	captan and fenhexamid
Capture	bifenthrin
Caramba	metconazole
Carbine	flonicamid
Carpovirusine	*Cydia pomonella granulosis* virus
Carzol	formetanate
Cease	*Bacillus subtilis*
Centric	thiamethoxam
Centaur	buprofezin
Champ	copper hydroxide
Chipco	aluminum tris o-ethyl phosphonate
Cinnacure	cinnamaldehyde
Closer	sulfoxaflor
Clutch	clothianidin
Cobalt	Chlorpyrifos and gamma-cyhalothrin
Comite	propargite
Companion	*Bacillus subtilis*
Condor	*Bacillus thuringiensis*
Confirm	tebufenozide
Coragen	chlorantraniliprole
Coronet	pyraclostrobin
Couraze	imidacloprid
Courier	buprofezin
Cruiser	thiamethoxam
Curzate	cymoxanil
Cyd-X	*Cydia pomonella granulosis* virus
Cygnus	kresoxim methyl
Cyzmic	lambda cyhalothrin
Daconil	chlorothalonil
Danitol	fenpropathrin
Deadline	metaldehyde bait
Declare	gamma-cyhalothrin
Decree	fenhexamid
Delegate	spinetoram
Demand	lambda cyhalothrin

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