VARROA DESTRUCTOR

THE MAJOR THREAT OF APIS MELLIFERA

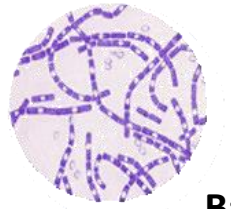
THE EUROPEAN HONEYBEE

JUNE, 2023

HONEYBEES UNDER ATTACK

Insects

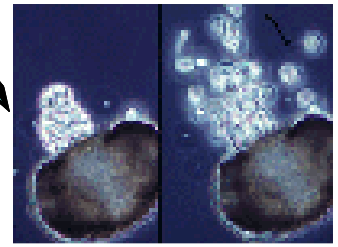
Virus



Bacteria

Varroa Mites

Yeast & Fungi



Tracheal mites

Pesticides

THE 3 P'S THAT CONTRIBUTE TO DECLINE OF HONEYBEE POPULATIONS

- **PESTS** AND DISEASES
  - VARROA/VIRUSES OVERWHELM IMMUNE SYSTEM

- **POOR NUTRITION**-MONOCULTURE FARMS
  - ALTERED FARM PRACTICES/CLIMATE CHANGE

- **PESTICIDES-**INDISCRIMINATE USE

FEMALE VARROA DESTRUCTOR

ALL HIVES HAVE VARROA

VARROA'S INTRODUCTION AROUND THE WORLD

- 1909-1958 JAPAN (First on A. cerana, native host, then on A. mellifera. Likely jumped species in the 1950's)
- Prior to 1965 USSR
- 1977 West Germany
- Late 1970's South America
- 1980 Poland
- 1982 France
- 1984 Switzerland, Spain, Italy
- 1987 Portugal
- **1987 United States of America**
- 1989 Canada
- 1992 United Kingdom

FROM EGG TO EMERGING ADULT

Understanding the life cycle of the Varroa mite

1

The queen is the largest in the beehive. She lays up to 2,000 eggs per day in the brood cells.

2

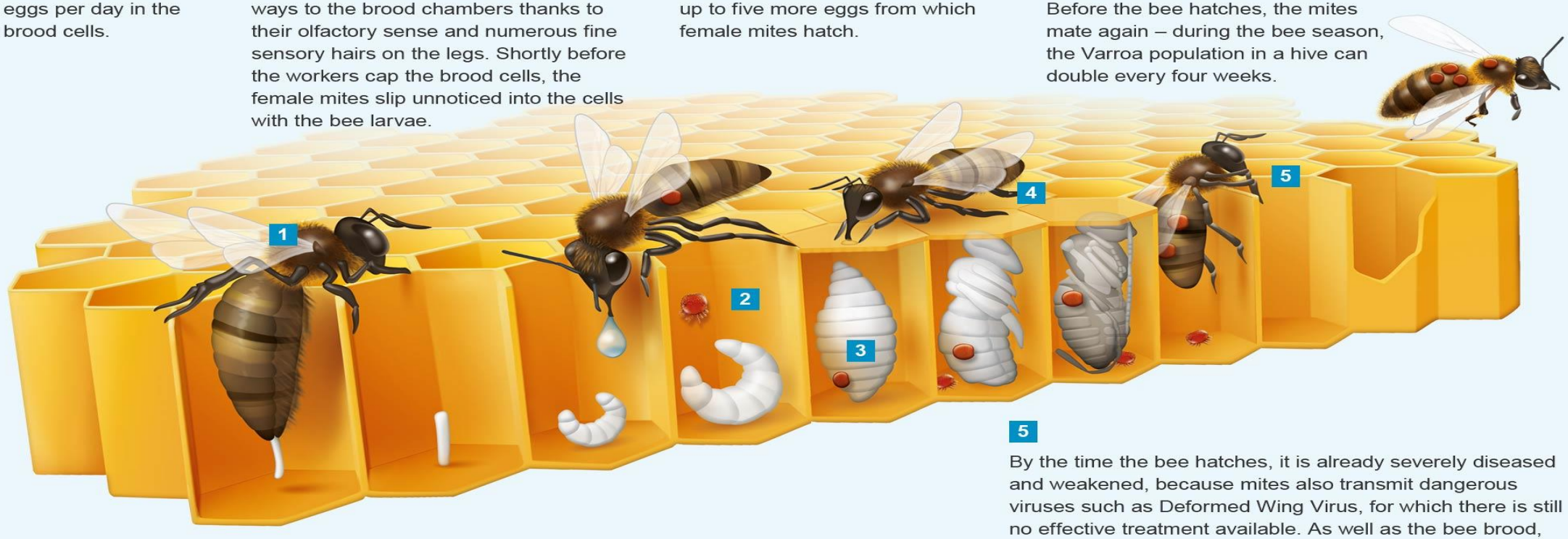
Worker bees often carry Varroa mites with them into the hive. Despite being deaf and blind, these mites can find their ways to the brood chambers thanks to their olfactory sense and numerous fine sensory hairs on the legs. Shortly before the workers cap the brood cells, the female mites slip unnoticed into the cells with the bee larvae.

3

A few days later, the mites lay the first eggs. The first to hatch is always a male. It is followed by up to five more eggs from which female mites hatch.

4

To feed its offspring, the mother mite pierces a feeding hole in the bee pupa which has developed in the meantime. Before the bee hatches, the mites mate again – during the bee season, the Varroa population in a hive can double every four weeks.



5

By the time the bee hatches, it is already severely diseased and weakened, because mites also transmit dangerous viruses such as Deformed Wing Virus, for which there is still no effective treatment available. As well as the bee brood, Varroa can also infest adult bees.

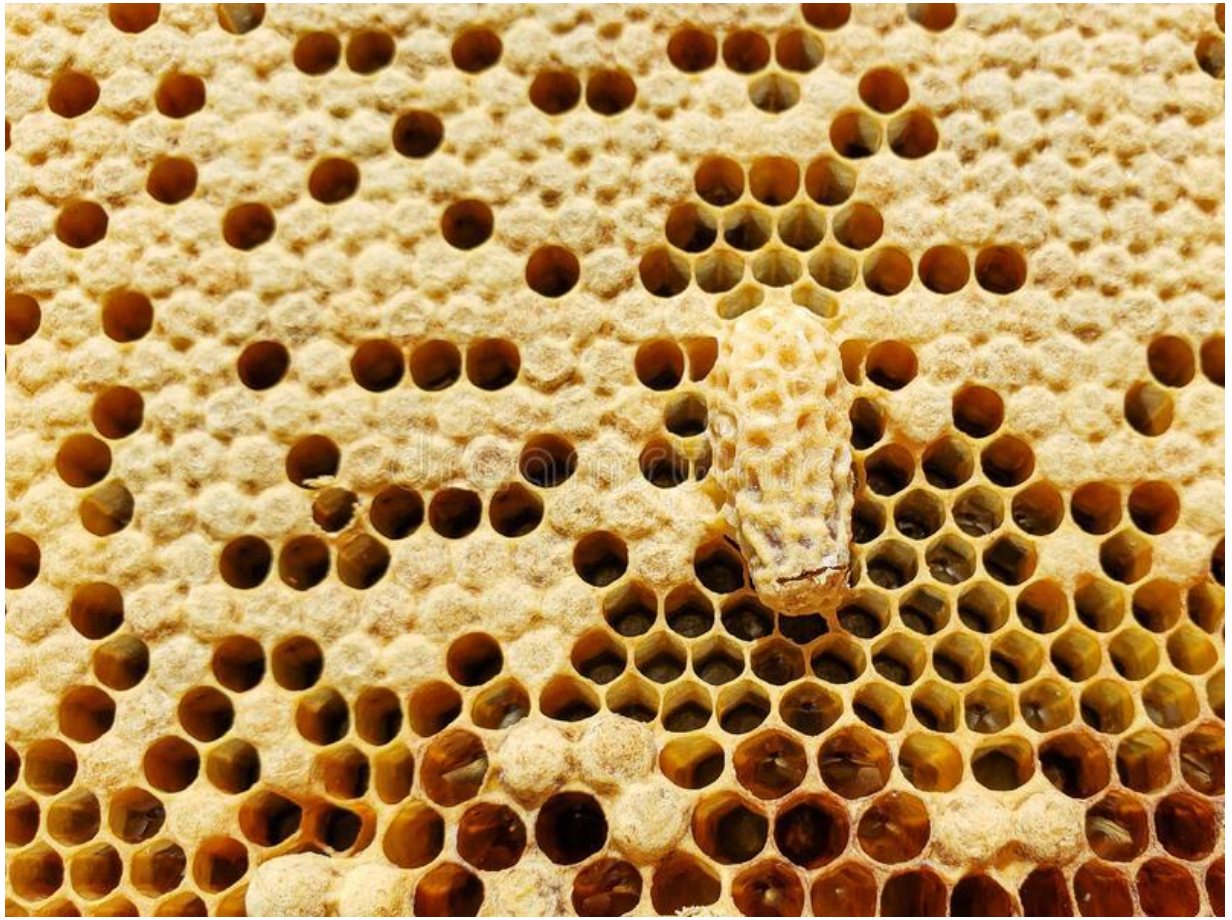
MITE TRANSFER (PHORETIC PHASE)

VARROA TRANSFER ON FLOWERS

PHORETIC PHASE

- THE PHORETIC FEMALE MITE USES VARIOUS CHEMICAL CUES, **PHERAMONES**, AS WELL AS NON-CHEMICAL CUES, **SIZE AND SHAPE OF THE CELL**, TO FIND A CELL SUITABLE FOR EGG LAYING DURING THIS PHASE.

WORKER CELLS VERSES DRONE CELLS



CELL INVASION BY PHORETIC FEMALE MITE

- OCCURS 15 TO 20 HOURS PRIOR TO CELL CAPPING IN THE CASE OF WORKER CELLS.
  - WORKER EGGS = 21 DAYS TO MATURITY
- OCCURS 40 TO 50 HOURS PRIOR TO CAPPING IN THE CASE OF DRONE CELLS.
  - DRONE EGGS = 24 DAYS TO MATURITY

DRONE LARVAE WITH MULTIPLE FEMALE MITES

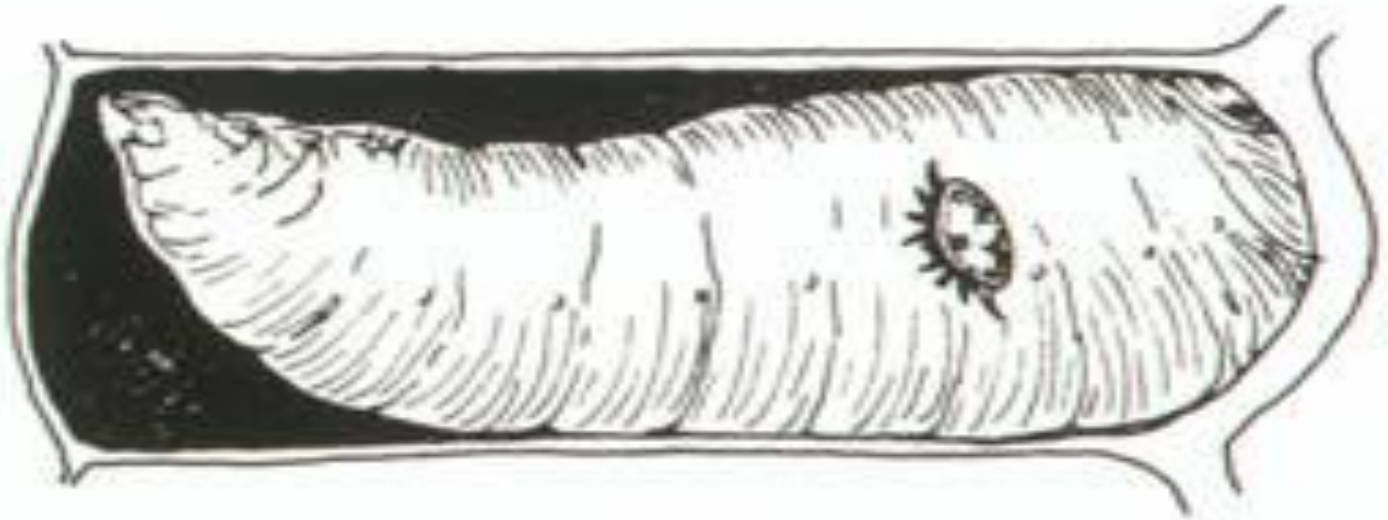
REPRODUCTIVE PHASE

- THE REPRODUCTIVE PHASE TAKES PLACE **EXCLUSIVELY** IN THE SEALED BROOD CELL OF THE HONEYBEE.
- FIRST EGG IS ALWAYS A MALE. SUBSEQUENT ARE ALL FEMALES.
- **WITHOUT BROOD**, THERE CAN BE **NO** REPRODUCTION.

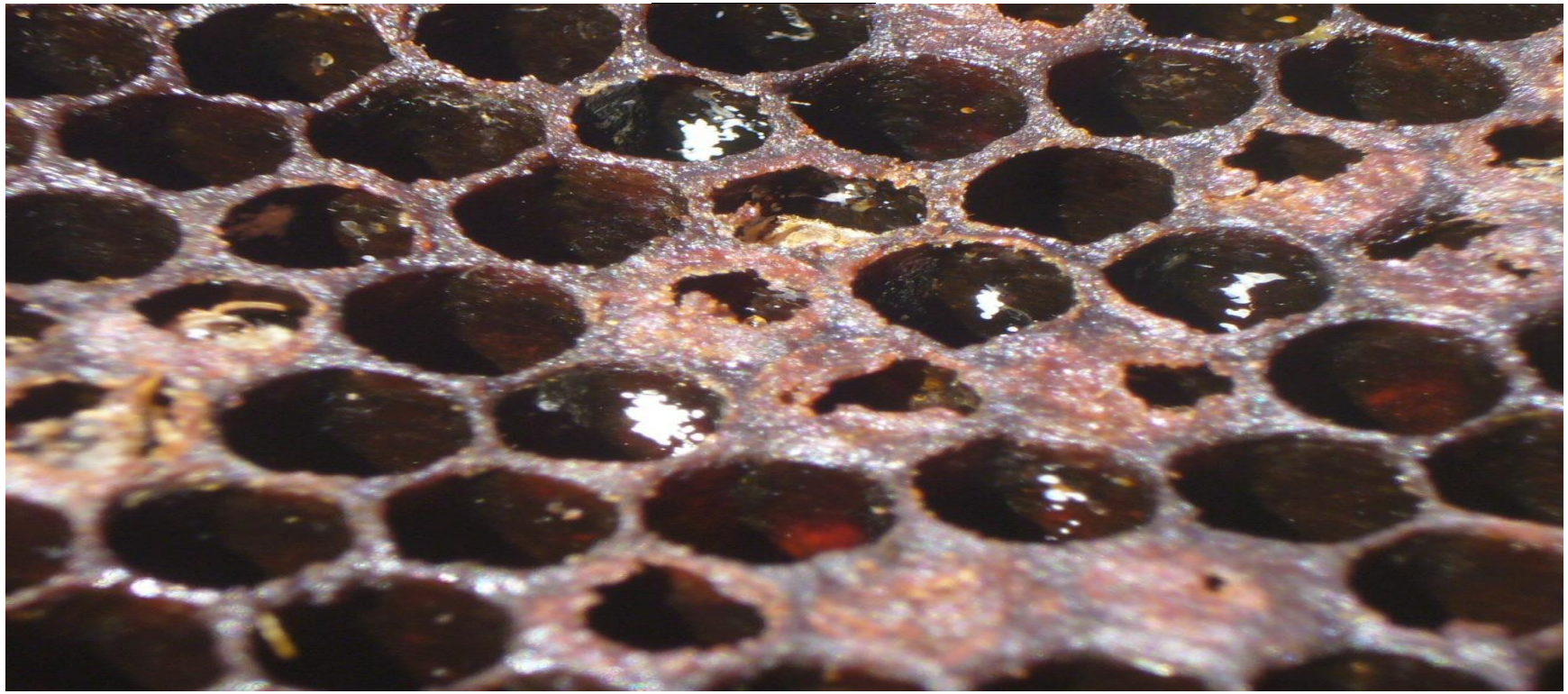
FEMALE MITE ENTERING CELL

MITE FINDS BEE FOOD

CELL CAPPED, BEE FOOD CONSUMED BY LARVA, MITE CREATES WOUND TO ENABLE ACCESS TO FAT BODIES FOR ITSELF AND OFFSPRING



VARROA GUANINE DEPOSITED AT FECAL ACCUMULATION SITE



MATING WITHIN THE CELL CONTINUES DURING PUPAL STAGE

ADULT FEMALE MITE ON A DEVELOPING BEE

VARROA ON DRONE PUPAE PRIOR TO EMERGING

MALE VARROA ARE SMALL AND COLORLESS AND DO NOT LIVE OUTSIDE THE CELL.

IMPACT OF INFESTATION

- PREMATURE LOSS OF ADULT BEES.
- LEARNING DISABILITES IN IMPAIRED ADULT BEES.
- LOWER RATE OF RETURN TO THE HIVE.
- REDUCTION OF HONEY YIELD.
- HONEYBEE VIRUSES.

VIRUSES

- CONSIDERED A MINOR PROBLEM TO HONEYBEE HEALTH PRIOR TO VARROA
- DEFORMED WING, ACUTE PARALYSIS, KASHMIR BEE VIRUS, PLUS OTHERS.
- DEFORMED WING VIRUS IS ONE EASILY VISABLE AND IDENTIFIABLE.

VARROA & DEFORMED WING VIRUS

DEFORMED WINGS/NORMAL WINGS

DWV, SHORTENED ABDOMEN

DWV SYMPTOMS

- SCATTERED BROOD NEST.
- SEEN CRAWLING AROUND FRONT OF HIVE.
- LOSS OF COORDINATED SOCIAL BEHAVIOR.
    - Grooming/Queen attendance/Cell cleaning.

PARASITIC MITE SYNDROME (PMS)

RESULT OF HIGH MITE INFESTATION

- ASSOCIATED WITH VARROA, VIRUSES OR COMBINATION, COLONY'S DETERIOATE, DIE.

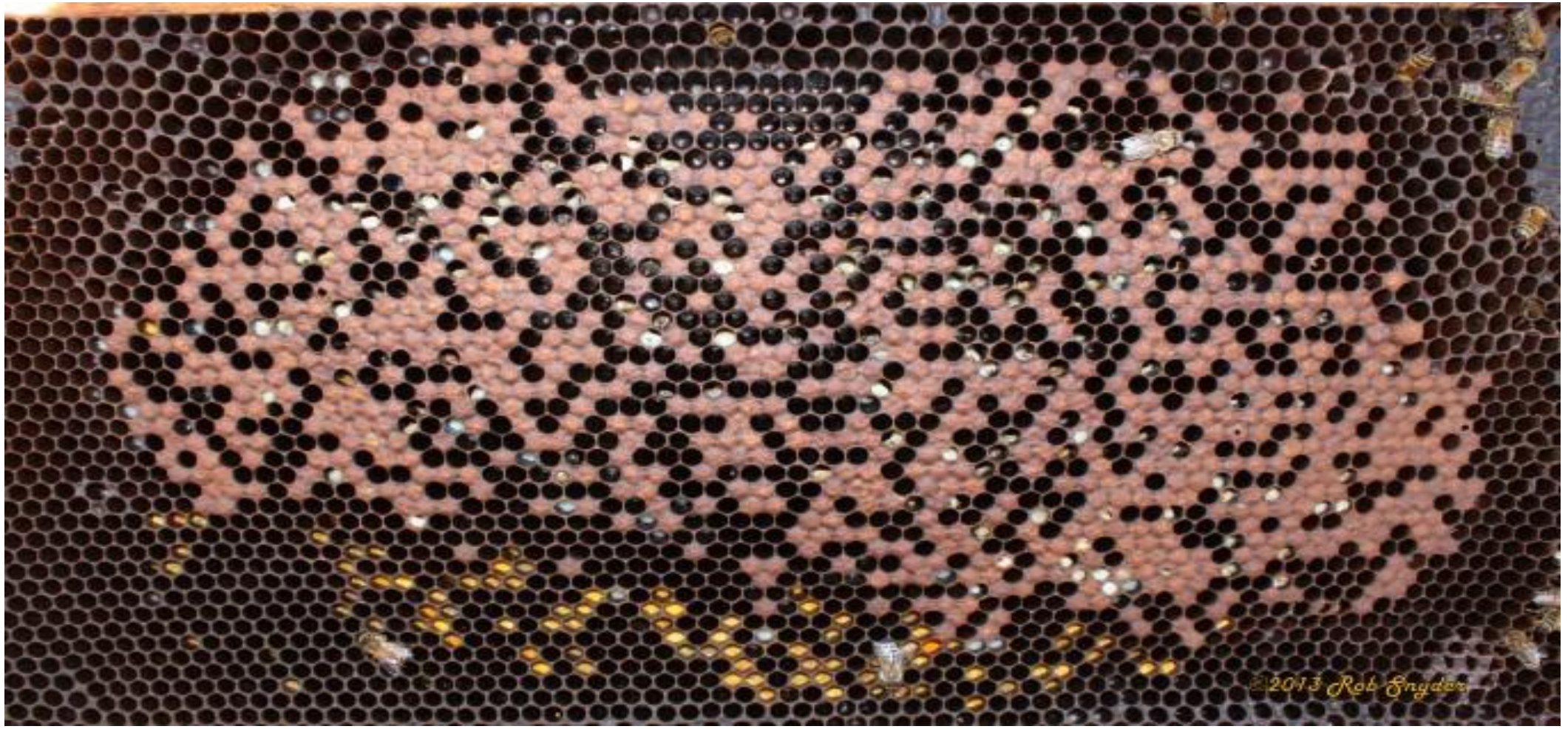
- HYGENIC BEES TRY TO REMOVE VARROA INFESTED CELLS BY OPENING THEM TO HALT DEVELOPMENT OF THE LARVAE OR PUPAE.

PARASITIC MITE SYNDROME

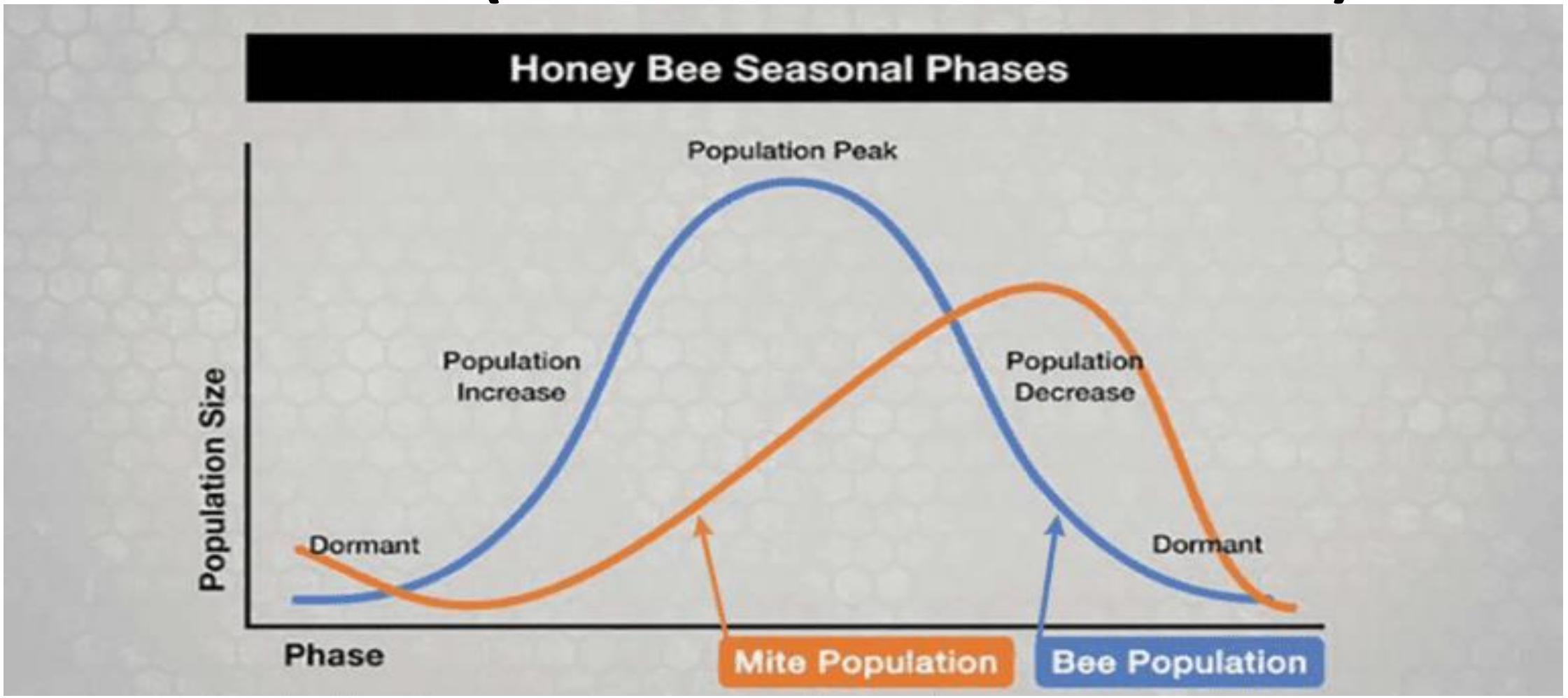
DISCOLORATION FROM DECOMPOSITION

PMS-SPOTTY BROOD PATTERN

BROOD PRODUCTION STOPS

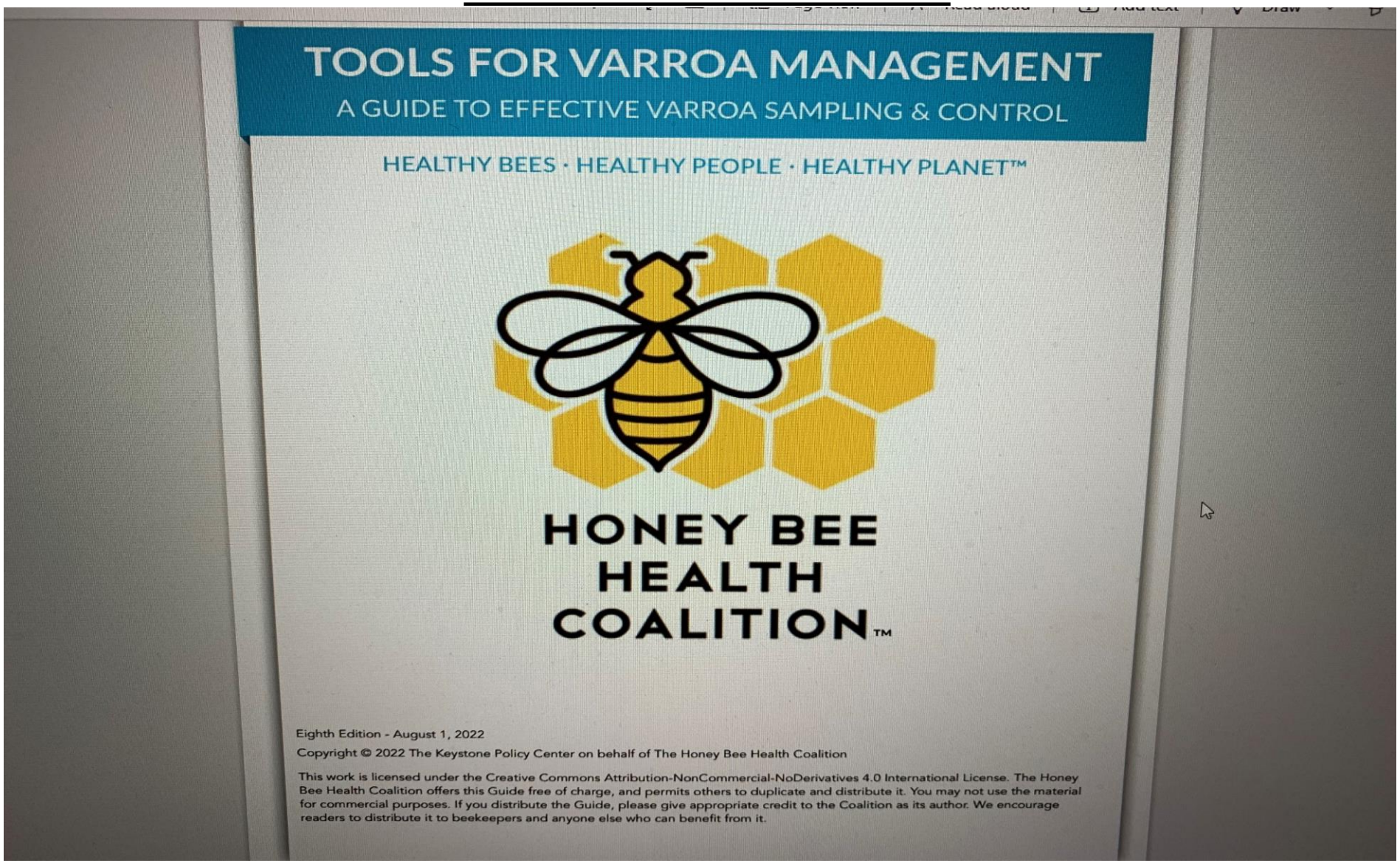


PACIFIC NORTHWEST HONEYBEE AND VARROA SEASONAL PHASES (JANUARY TO DECEMBER)



SOURCE OF LEGAL TREATMENT

UPDATED AUGUST 2022



METHODS OF CONTROL
4TH DECADE BATTLE

- **INTEGRATED PEST MANAGEMENT STRATIGIES. (IPM) SUPPRESS #'S**
- **AID IN ASSESSING MITE LOAD TRENDS.**
- **GOAL: KEEP MITE POPULATION BELOW ECONOMIC THRESHOLD.**

INTEGRATED PEST MANAGEMENT STRATIGIES

SUPPRESS VARROA NUMBERS

SCREENED BOTTOM BOARDS,
DRONE FOUNDATION
BROOD BREAK-NO BROOD, NO REPRODUCTION

POPULATION MONITORING

- MONITOR TO **ESTIMATE** MITE INFESTATION LEVEL VIA IPM STRATIGIES.
- **ACCURATE** ASSESSMENT OF MITE POPULATION TO DETERMINE IF TREATMENT IS NECESSARY IS ESSENTIAL.
- WAITING TO CONFIRM LEVELS IS RISKY.
- MONITOR AT LEAST 4 TIMES A YEAR, BEGINNING WITH POPULATION INCREASE PHASE.

ECONOMIC THRESHOLD DETERMINATION

- BEST METHOD TO DETERMINE MITE POPULATIONS ARE ALCOHOL WASH, SUGAR SHAKE, OR NON-SUDSING SOAP WASH TO KNOW %.

HOW TO CALCULATE % OF MITES

- SAMPLE 300 ADULT BEES, ½ CUP, USE ALCOHOL OR SOAP WASH OR POWDER SUGAR SHAKE.
- COUNT THE MITES, DIVIDE THAT NUMBER BY THE NUMBER OF BEES.
- MULTIPLY BY 100 TO YIELD A PERCENTAGE.

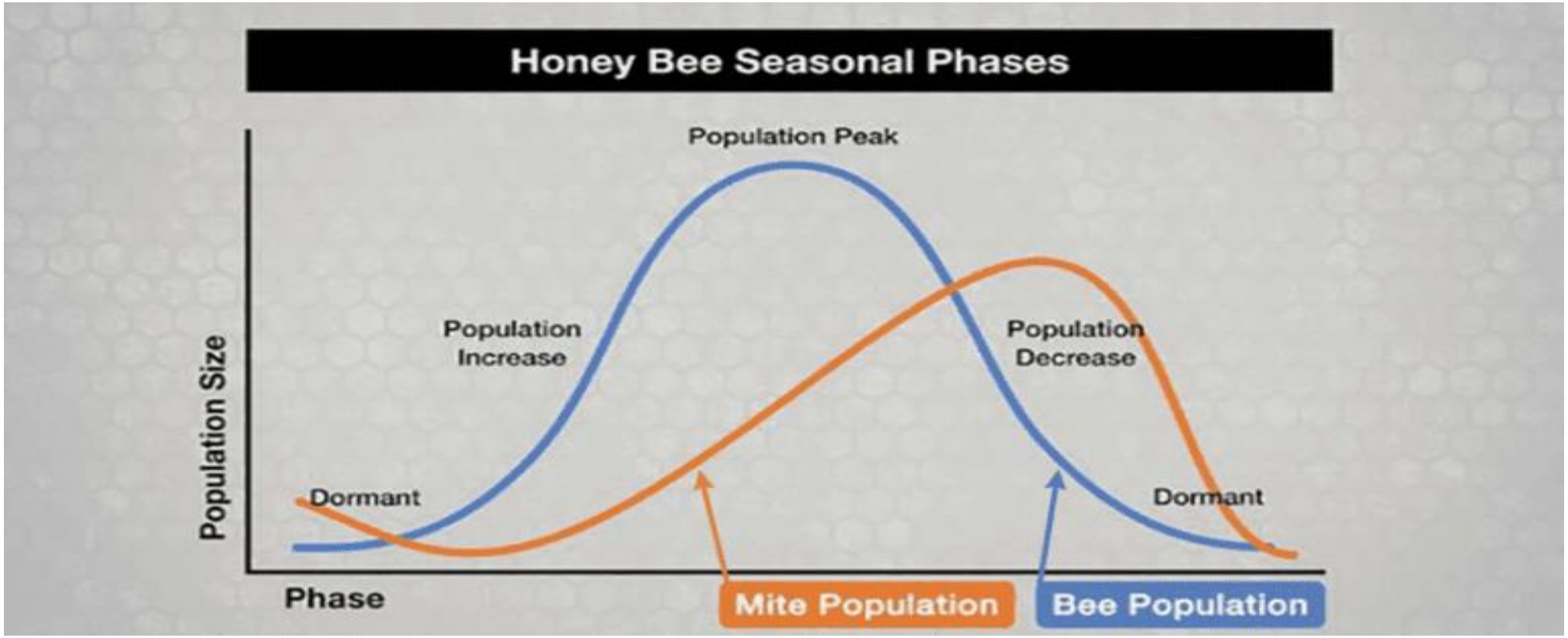
EXAMPLE: 12 MITES DIVIDED BY 300 BEES = .04 X 100 = 4%

INTERPRETING SAMPLE FINDINGS

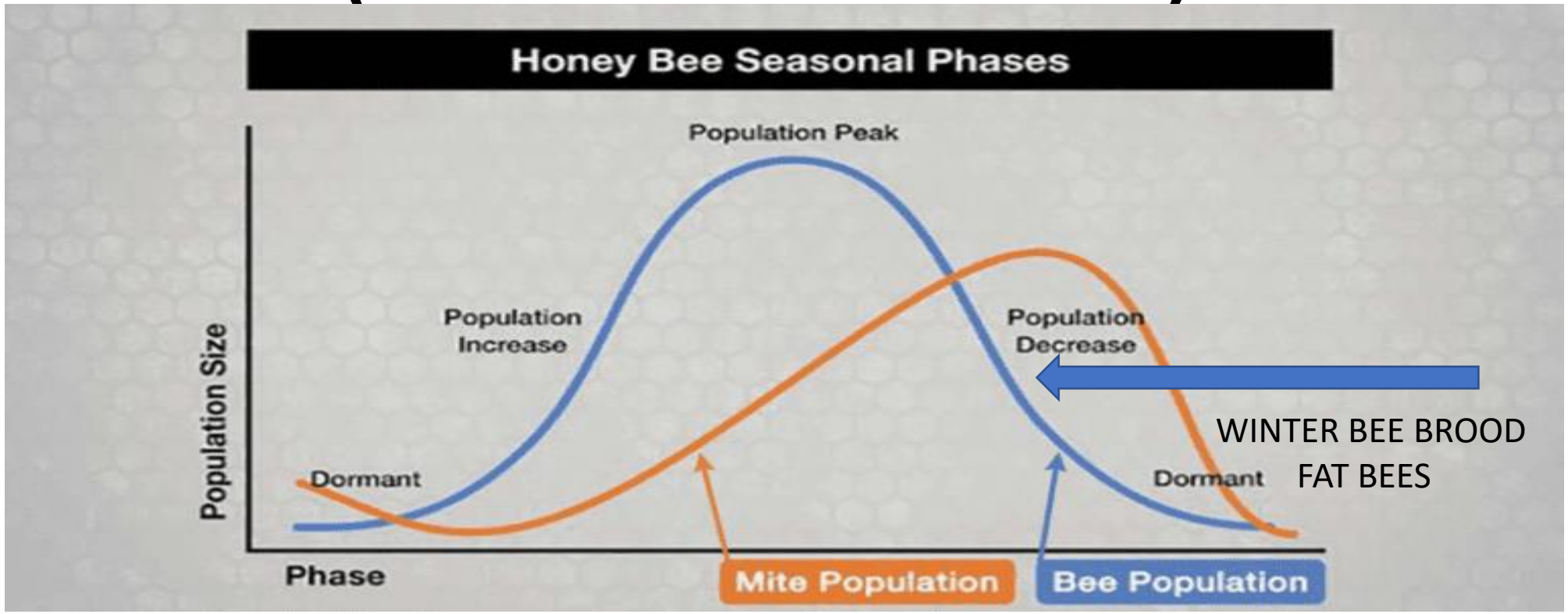
COLONY PHASE	IMMEDIATE CONTROL NOT NEEDED	% PROMPTLY CONTROL
DORMANT	<1%	>1%
POPULATION INCREASE	<2%	>2-3%
PEAK POPULATION	<2%	>3%
POPULATION DECREASE	<2%	>2-3%

CONTINUE MONITORING THROUGH PNW HONEYBEE POPULATION PHASES

- BEGIN WITH HONEYBEE POPULATION INCREASE. TREAT >2%
- MONITOR REGULARLY THROUGH THE PEAK. TREAT >3%



PACIFIC NORTHWEST HONEYBEE DECREASE PHASE (AUG-SEPT TO NOV-DEC)



Eggs laid during this phase = winter bees; live up to 6 months, varroa multiplying rapidly as bee population decreases. Frequent monitoring to confirm levels are low, <1% going into dormant phase.

HIGH MITE LOADS WILL CAUSE WINTER BEES TO HAVE INADEQUATE FAT BODY STORES.

ROLE OF FAT BODIES

- FAT BODY TISSUE CONTAINS LIPIDS, GLYCOGEN, TRIGLYCERIDES AND PROTEIN.

- FAT BODY TISSUE DETOXIFIES HARMFUL COMPOUNDS, PLAYS A ROLE IN BEE DEVELOPMENT, SYNTHESIZES AND STORES PROTEINS AND FATS.

ROLE OF FAT BODIES (CON'T)

- FAT BODIES STORE ENERGY WHEN FOOD IS PLENTIFUL AND RELEASE ENERGY WHEN THE BEES NEED IT. (IN CLUSTER)

- THIS ENERGY IS ESPECIALLY IMPORTANT DURING LARVAL GROWTH AND DURING PERIODS WHEN FEEDING IS RESTRICTED, AS IN THE WINTER MONTHS.

VITELLOGENIN
"AN AMAZING MOLECULE"

- BEES STORE FOOD RESERVES IN THEIR **FAT BODIES** IN THEIR ABDOMEN AND HEAD IN THE FORM OF VITELLOGENIN.

- DURING LARVAL STAGE, **FAT BODIES** COVER MOST OF THE LARVAE.

- IT IS A GLYCOLIPOPROTEIN, HAVING PROPERTIES OF SUGAR, FAT AND PROTEIN.

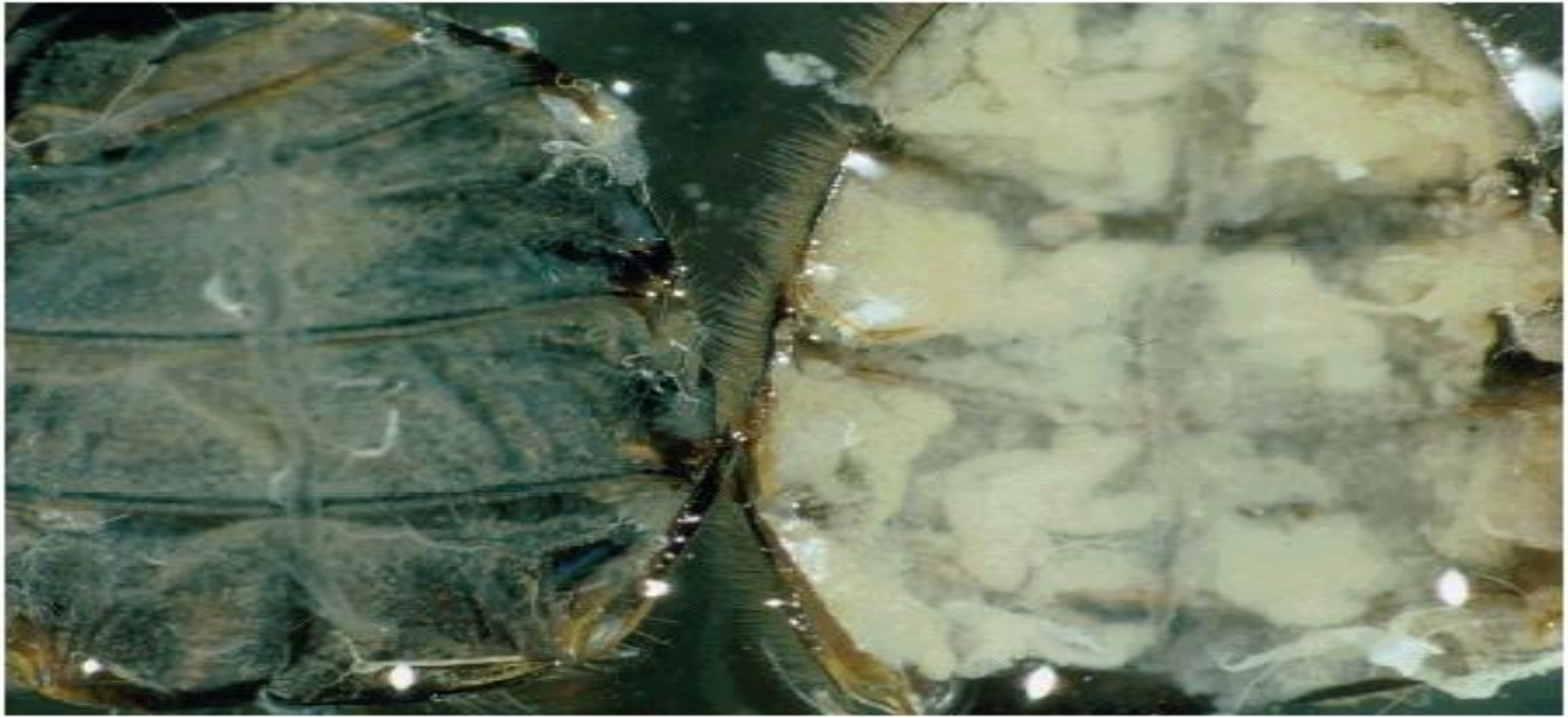
VITELLOGENIN

- IT SYNTHESIZES ROYAL JELLY.
- AN IMMUNE SYSTEM COMPONENT.
- PROLONGS QUEEN/FORAGER LIFESPANS.
- AIDS IN BROODING UP IN EARLY SPRING.
- A LARVAL PROTEIN SOURCE.

LACK OF VITTELLOGENIN STORES

- PESTICIDE DETOXIFICATION. BEES WITH COMPROMISED FAT BODIES ARE MORE SENSITIVE TO PESTICIDES.
- IMMUNE FUNCTION IS REDUCED.
- METABOLIC ACTIVITY IS REDUCED, PROBLEMATIC IN WINTER CLUSTER WITH THE NEED TO ACTIVATE FLIGHT MUSCLES TO GENERATE HEAT.
- THE MORE VITTELLOGENIN, THE BETTER EQUIPPED TO SURVIVE THE LONG WINTER. **FAT BEES**

FAT BODIES, REDUCED IN FORAGER FULLY DEVELOPED IN “WINTER BEE”



TREATMENT

- CULTURAL CONTROL-DRONE COMB CULLING; DRONE FOUNDATION, REQUEENING WITH HYGIENIC QUEENS.
- PHYSICAL CONTROL-SCREEN BOTTOM BOARDS.
- CHEMICAL CONTROL-MITICIDES, ESSENTIAL OILS.
- DON’T BE CHEMOPHOBIC BUT DO NOT USE CHEMICALS TOO READILY. BE RESPONSIBLE, AVOID RESISTANCE.

RECOMMENDED CONTROLS BY SEASONAL PHASE

- READ TOOLS FOR VARROA MANAGEMENT GUIDE FOR INFORMATION ON APPROVED CHEMICAL CONTROLS.
- **DIFFERENT CONTROL OPTIONS APPROPRIATE FOR EACH OF THE 4 POPULATION PHASES OF THE HONEYBEE AND VARROA SEASONAL CYCLES ARE LISTED ON PAGE 13-14.**
- SUPPORTING VIDEOS DEMONSTRATE PROPER USAGE.

ESSENTIAL REMINDER

ALWAYS REPEAT SAMPLING AFTER TREAMENT TO CONFIRM EFFECTIVENESS OF THE TREATMENT USED.

LCBA WEBSITE

- LCBAOR.ORG

- IMPORTANT VARROA INFORMATION

- Why Did My Bees Die This Winter? - Even if you didn't think you had Varroa present
  Tools For Varroa Management - Honey Bee Health Coalition With Supporting Videos

VARROA MITES DO NOT CONSUME HONEYBEE HEMOLYMPH

- THE FIRST RESEARCH PAPER'S PUBLISHED IN THE 1960'S REPORTED VARROA MITES FED ON THE HONEYBEE HEMOLYMPH, A FLUID EQUIVALENT TO BLOOD.
- DR. SAMUEL RAMSEY PUBLISHED DIFFERING RESULTS OF STUDY IN 2019.

RESEARCH DISCOVERIES

- HEMOLYMPH IS LOW IN NUTRIENTS.
- GROWTH AND REPRODUCTION OF VARROA REQUIRE MORE THAN AVAILABLE FROM 1 BEE.

RESEARCH DISCOVERIES CONTINUED

- VARROA MITE EXCREMENT IS DRY; CONTRARY TO EXPECTED WITH A LIQUID DIET.

- VARROA MOUTH PARTS ARE ADAPTED FOR DIGESTING SOFT TISSUE WITH ENZYMES, NOT ADAPTED FOR SUCKING. BLOOD FEEDING MITES AND TICKS MOUTHS ARE ADAPTED FOR PIERCING/SUCKING.

RESEARCH METHODS

- OBSERVED MITES FEEDING LOCATIONS ON ADULT BEES.
- USED FLORESCENT MARKERS TO TEST WHAT WAS BEING CONSUMED.
- FED VARROA **ONLY** HEMOLYMPH OR **ONLY** FAT BODY, MONITORING HOW LONG THEY WOULD SURVIVE.

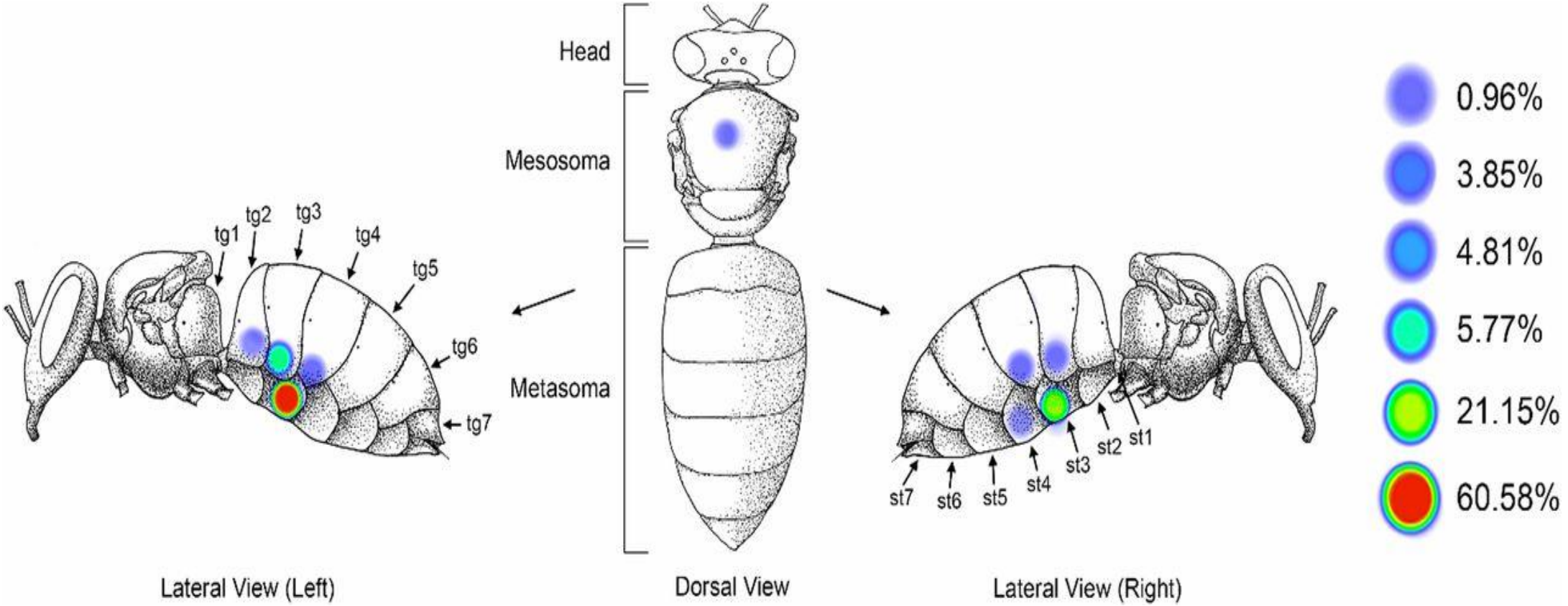
RESEARCH RESULTS

- VARROA CONSISTENTLY FED IN ONE SPOT.
- WOUND SITE SHOWED MITES FEED DURING TRANSPORT ON ADULT BEES.
- **MITES FED FAT BODY TISSUE SURVIVED LONGER THAN MITES FED HEMOLYMPH AND MITES FED HEMOLYMPH FARED NO BETTER THAN MITES FED NOTHING.**

RESULTS OF STUDY

- VARROA CONSUME
- FAT BODY TISSUE,
- NOT HEMOLYMPH.

PREFERRED FEEDING SITES ON ADULT HOST HONEY BEES



ELECTRON MICROGRAPH SHOWING VARROA WEDGED BETWEEN ABDOMINAL PLATES OF A HONEYBEE

VARROA ON ADULT BEE THORAX

PhD STUDENT FINDINGS
USDA BELTSVILLE BEE LAB

- ZAC LAMAS HAS DEMONSTRATED EARLY SPRING MITES ARE NOT RANDOMLY DISTRIBUTED.
- OUR SAMPLING METHODS IMPLY A RANDOM DISTRIBUTION OF MITES.
- MITES ARE NOT ON NURSE BEES NOR IN WORKER BROOD IN EARLY SPRING. THEY ARE PRIMARILY ON ADULT DRONES AND REPRODUCING IN DRONE BROOD.
- DRONE BROOD REMOVAL MAY BE POWERFUL TOOL TO HELP REDUCE MITE BUILDUP IN THE SPRING.
- QUESTION: HOW DO WE MEASURE MITE POPULATIONS IN EARLY SPRING WITHOUT SAMPLING?

“BEE” AWARE AND CARE

- BE ATTENTIVE TO WHAT IS OCCURING IN THE HIVE.
- ENSURE ADEQUATE SOURCES OF NUTRIENTS IN EARLY SPRING TO AVOID STARVATION AND IN LATE SUMMER AS FAT BEES ARE ESSENTIAL TO SURVIVE THE WINTER.
- TAKE CARE OF YOUR BEES. THEY NEED YOUR HELP TO SURVIVE VARROA.

SHARING THE WEALTH

DISCOVERY BY RESEARCHERS

- They observed where mites feed on **adult bees**.
- They marked bee organs (fat body and hemolymph) with fluorescent markers to test which organ Varroa were eating.
- They fed Varroa only hemolymph or only fat body and monitored how long the mites would survive.
- **Results**: Varroa consistently fed in one spot. The wound site showed evidence that mites feed during transport on adult bees. The markers showed that **Varroa consume fat body tissue, not hemolymph**. Mites fed fat body survived longer than mites fed hemolymph and mites fed hemolymph fared no better than mites fed nothing.

HONEY

- NECTAR IS CONVERTED TO HONEY VIA THE ENZYME, INVERTASE, IN THE HONEY SAC AKA HONEY STOMACH.
- STORED IN CELLS UNTIL MOISTURE CONTENT IS 13-18%, THEN CAPPED WITH WAX.
- WINTER AND EARLY SPRING IS WHEN COLONY IS MOST AT RISK FOR STARVATION. FIRST ½ OF WINTER, 30% UTILIZED, WHEN BROOD REARING STARTS, OTHER 70% IS USED)

CONTINUAL MONITORING

- BEGIN WITH HONEY BEE POPULATION INCREASE.
- CONTINUE TO MONITOR REGULARLY THROUGH THE PEAK.
- DURING POPULATION DECREASE, MITE LEVELS SHOULD BE CHECKED MORE FREQUENTLY TO CONFIRM INFESTATION LEVELS ARE LOW GOING INTO THE DORMENT PHASE OF THE HONEYBEE. (MORE LATER)
- SAMPLING DURING DORMENT PHASE IS LESS IMPORTANT, AND ALSO IT MAY BE TOO COLD TO SAFELY SAMPLE.
- **ALWAYS REPEAT SAMPLING AFTER TREATMENT TO CONFIRM EFFECTIVENESS OF THE TREATMENT!**

POLLEN

- MAJOR SOURCE OF PROTEIN-MAIN NUTRIENT FOR THE COLONY COMES FROM POLLEN.
- USED TO FEED DEVELOPING LARVAE AND YOUNG BEES TO PROVIDE STRUCTURAL ELEMENTS OF MUSCLES AND GLANDS.
- USED IN PRODUCTION OF ROYAL JELLY.
- WAX GLANDS USE LARGE AMOUNTS OF PROTEIN.

NEWLY HATCHED ADULT WORKER BEE

- FIRST EAT NECTAR, A SHOT OF SUGAR FOR ENERGY. BROOD COMBS ARE RINGED BY CELLS OF OPEN NECTAR OR HONEY, READILY AVAILABLE.
- NEXT THEY SEEK OUT CELLS OF STORED POLLEN NEXT TO THE BROOD AND BEGIN THE PROCESS OF BUILDING UP HER BODY PROTEIN LEVEL.
- BY DAY FIVE, HER BROOD FOOD GLANDS AND FAT BODIES ARE FULLY DEVELOPED, **PROVIDED ADEQUATE POLLEN** IS AVAILABLE, AND SHE CAN PRODUCE ROYAL JELLY.
- NOW, SHE ONLY CONSUMES POLLEN IF NEEDED FOR BROOD REARING OR TO FATTEN UP FOR WINTER.

BROOD, NECTAR, POLLEN, HONEY

PERFECT FRAME
TAKEN AT JASON ROWAN'S