DECLINING BEE POPULATIONS IN CENTRAL CALIFORNIA

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WHAT?

The pollinator population has been on a steep decline since the early 2000s, with beekeepers reporting an average loss of 30 percent of all honeybee colonies each winter. Specifically in California, around 270,000 colonies were lost between 2015 and 2017; this was 70,000 more than those lost nationwide. Bee population in the winter is expected to decline, normally averaging around 17% loss in population; however, that percentage has more than doubled in recent years.

SO?

With almonds being the state's largest overseas export, California needs 1.6 million domesticated bee colonies to upkeep and pollinate 800,000 acres of the flowering trees. This doesn't include the number of bees needed to pollinate other staple crops like apples, avocados, and grapes. After mid-march, the bees that were being used to pollinate the almonds are then shipped around the US for other pollination services. Declining bee populations will leave these crops unpollinated, leaving farmers cropless, beekeepers jobless, and consumers hungry. Moreover, local environments will suffer from diseases due to a lack of genetic diversity and pollination among plants; many animals and insects that prey on bees lose out on an important food source.

WHY?

We chose to study central California specifically because of the staggering colony losses, losing more bee colonies than the rest of the United States combined. With California being one of the world's agricultural giants, producing $7.34 billion in milk, $6.09 billion in almonds, and $5.41 billion in grapes. Declining pollinator populations would thus have a disproportionate impact not only on California, but on the rest of the United States with one of California's largest industries taking a hit. California's liberal legislation allows for our group to study the current solutions and interventions applied to this complicated web of interactions.

CAUSES

URBAN DEVELOPMENT
- HABITAT DESTRUCTION
- LOW GENETIC DIVERSITY
- LOSS OF FOOD SOURCES
- LOSS OF SHELTER
- HABITAT DEGREDATION

INDUSTRIAL FARMING
- PESTICIDES
  - Neonicotinoids
  - Glyphosate
- HERBICIDES
- MIGRATION

NON-NATIVE SPECIES
- COMPETITORS
- NON-NATIVE PARASITES
- PREDATORS

PATHOGENS & PARASITES
- CCD
- MITICIDES
- DMV
- VARROA

CLIMATE CHANGE
- GLOBAL WARMING
  - SHIFTS IN SEASONS
  - HABITAT RANGE
- RISK OF DISEASE

EFFECTS

DIMINISHING FOOD CROP YIELDS
- BEE POLLINATION IN AGRICULTURE
- FOOD INSECURITY
- ALMONDS

ECONOMIC DEPENDENCE
- INCREASED FOOD PRICES
- JOB LOSS (BEEKEEPERS)
- GLOBAL IMPACT

CULTURAL IMPRESSIONS
- ETHNOBOTANY
- CULTURAL SYMBOLISM

ENVIRONMENTAL EFFECTS
- CARBON CYCLING
- WILD PLANT GROWTH
- SOIL EROSION

DECREASED BIODIVERSITY
- FOOD CHAIN
- KEYSTONE SPECIES
- HABITAT CREATION
- INDICATOR SPECIES
- FOOD PRODUCTION

RESEARCH

MONITORING
- Monitoring bee populations involves action in the state and local scale. It also requires a network of beekeepers, farmers and researchers to collect and analyze data. Sound, visual, and infrared sensors are placed around bee hives to collect crucial data.
- Researchers are currently experimenting with drone pollinators. These drones fly over crops and disperse pollen from above. The goal is for these drones to eventually replace pollinators in farms reducing the reliance of agriculture on pollinator populations.

DATA ANALYZATION
- Data collected by beekeepers and farmers include visual, sound, and infrared data. Data analyzation will have to compile several different types of data inputs.
- There are organizations that are using artificial intelligence and data analytics to monitor bee populations. Data is analyzed by the AI for behavioral patterns, which is passed on to beekeepers. AI can also run accurate simulations of bee hives and bee populations allowing scientists to predict patterns.
- Studies have shown it is possible to breed new honey bees that are resilient to pathogens and parasites that were previously lethal towards them.

EXISTING PROTECTION

NATIONAL GOVERNMENTAL POLICIES
- USFWS
- USDA
- EPA
- 2015 WHITE HOUSE NATIONAL STRATEGY
- SENATE

STATE GOVERNMENTAL POLICIES
- PERMITS
- PESTICIDE LABELING

NON-PROFIT ORGANIZATIONS
- POLLINATOR PARTNERSHIP
- UNITED NATIONS DEVELOPMENT PROGRAM
- BEEKEEPERS

UNIVERSITY RESEARCH
- UNIVERSITY OF CALIFORNIA
- UC BERKELEY
- UC DAVIS

LARGE CORPORATIONS
- NEONICS
- SUBSIDIES

INTERVENTION 1
IMPROVING THE EFFECTIVENESS OF GOVERNMENTAL POLICIES & ACTION

As designers, our responsability is to improve existing public policies towards beekeepers and pollinator habitats, while implementing new strategies based on leverage points 5 and 12 to encourage bitpartisan cooperation between local, state, and federal governments as well as non-profit organizations.

- GLOBAL
- NATIONAL
- STATE

Improvements in governmental policies include banning bee-killing pesticides (neonicotinoids), which contribute towards Colony Collapse Disorder and other fatal diseases. Many states have taken legal actions against these pesticides; however, the EPA has still taken no official action. Punishments could be enforced for chemical corporations not abiding these laws.

Leverage point 5: The rules of the system (incentives, punishments, constraints)

Under the Trump administration, the US Department of Agriculture announced that it would no longer fund national surveys on honeybee populations, which are critical in monitoring pollinator populations. Resolving political disputes is critical for environmental progress. Establishing incentives and payment for pollinator services could also motivate farmers to manage their native pollinators with better care. This is modeled off the existing "Farming with Alternative Pollinators" project in Uzbekistan and "Integrated Crop Pollination."

Increased government partnership with non-profit organizations can be an effective way to increase global awareness. Support for the "Pollinator Partnership" program and the United Nations Developmental Program can further provide beekeepers with stable wages to maintain proper habitats for bees.

Transportation of pollinators in and out of California requires a state permit; however, these are limited to only a few species and not strictly enforced. Fines for beekeepers who do not register for prior approval of bee migrations or taxes can prevent the exploitation of bees.

Future beneficial state governmental policy strategies include enhancing pollinator habitats through providing incentives for habitat conservation, mandatory conservation set-asides in specific areas where heavy declines are occurring, invoking endangered species laws, and furthering habitat planting on public land including parks and roadsides. Existent programs similar to these include the "Urban Pollination Project" in the UK. Providing funding towards state and local research towards pollinator protection for universities could also promote finding sustainable alternatives to bee pollination methods.

Leverage point 12: Constants, parameters, numbers (subsidies, taxes, standards)

INTERVENTION 2
TECHNOLOGICAL IMPROVEMENTS TO THE POLLINATOR PROCESS

By changing the goal of the system (leverage point 3) from protecting and preserving preexisting methods of pollination or pollinators, designers and researchers can use their capabilities to create new methods of pollination.

INTERVENTION 3
INCREASING SOCIAL AWARENESS AND ACTIVISM

- GLOBAL
- NATIONAL
- STATE

There are several organizations movements that are trying to increase public awareness. One of these movements is the Save the Bees movement which is promoted by organizations such as Green Peace. Many companies have taken to the cause as well by releasing merchandise and advertisements. Social Media is also a hotbed for activism with the #BringBackTheBees tag trending on twitter.

Several United States Federal organizations have initiatives educating the public on declining pollinators and pollinator protection. These organizations include the Fish and Wildlife Service, the Forest Service, the Department of Agriculture, and the Environmental Protection Agency. The US Airforce has even released a pollinator conservation reference guide.

People should be encouraged to buy honey from their local pesticide free farms and beekeepers. Local volunteer groups and movements through public spaces such as schools and parks should educate the population on declining pollinators as well as encourage people to plant bee-friendly plants and monitor their local invasive species. People should also be motivated to reduce their pesticide use when gardening and landscaping.

Leverage point 6: Access to Information, Managing information flow

KEY

- STATE
- NATIONAL
- GLOBAL
- STAKEHOLDERS
- FEEDBACK LOOPS
- STAKEHOLDER INTERACTION
- \+ POSITIVE
- — NEGATIVE

Work Cited: tinyurl.com/systems-pollinators
Process Boards: https://miro.com/app/board/o9J_lMbcV8s=/ (miro)
tinyurl.com/pollinators-figma (figma)