The Root Causes of CCD: Beyond "Disappearing Disease"

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Topics in This Talk:

- Look at “disappearing disease”
- Look at Colony Collapse Disorder (CCD)
- Compare the above conditions
- Detail how the challenges of beekeeping have changed, especially in the last two decades
- Propose a new paradigm in beekeeping education
- Conclusions

History of Disappearing Disease

- The "Isle of Wight" phenomenon; the first discussion of a disappearing disease? U.S. losses: 1868 and 1871? J. Kulencevic, et. al. OARDC
- Large losses on the Isle of Wight 1901 – 1905 ; correlated with detection of the tracheal mite (*Acarapis woodi*)
- Provoked debate between Dr. L. Bailey and Brother Adam of "Buckfast Bee" fame; breed from survivor bees

Dr. Bailey's Take:

- Mite a scapegoat for large colony losses. Beekeepers did not understand the disastrous effects of their own actions including experimental treatments, moving bees and especially **transferring bees from skeps to moveable-frame hives**. Beekeepers not aware of all possibilities and were searching for specific answers to a complex problem.

Brother Adam's Take:

- A **new disease**; spread was very rapid since many incidences were reported on the British Isles when infested bees were moved in. Weather factors not contributive and honey flows better than average; a transition period from skeps to moveable-frame hives did occur, but beekeepers did not lack skills or experience. Symptoms of nosema disease more like "disappearing disease" and the queen was usually not affected, which is the case in nosema.

History of Disappearing Disease

- 1915 losses considerable; symptoms "broad and indistinct," appearing to be a collage of characteristics.
- Other names over time: fall/spring dwindling, autumn collapse, May disease (Mal de Mayo), Mary Celeste Syndrome (ghost ship)
- ABJ paper 1979, William Wilson and Diana Menapace based on 1975 bee inspector survey

Disappearing Disease 1975

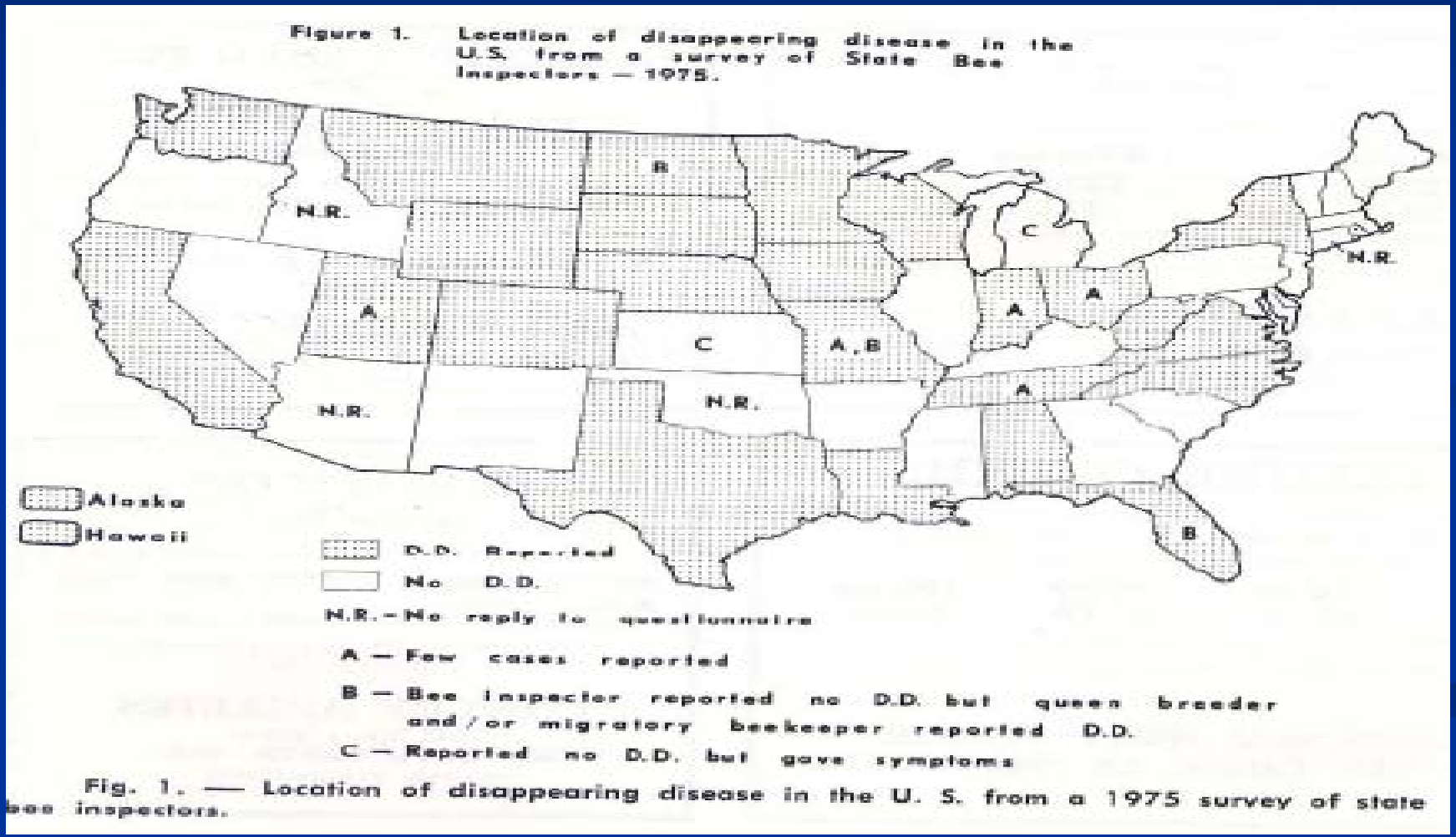


Fig. 1. — Location of disappearing disease in the U. S. from a 1975 survey of state bee inspectors.

Conclusions in 1979

- Distinct and identifiable: found in most regions
- Loss of workers; a serious beekeeping problem
- Losses greatest in Spring; bad weather correlated
- Most affected: honey producers in the north purchasing queens and packages from the south
- Dwindling during cool weather, where Nosema incidence is low caused by pesticides or DD.

History of Disappearing Disease

- Kulencevic, Rothenbuhler, Rinderer 1984 OSU OARDC Wooster Research Bulletin 1160
- No genetic correlation: used seven stocks of bees, some with DD history
- Possible causes: Nosema, EFB, nutritional deficiencies (correlated with Australian losses) and pesticides
- Dr. Rothenbuler: Pollen shortages

History of Disappearing Disease

- Florida 1984: correlated with first appearance of tracheal mite (*Acarapis woodi*); the "Isle of Wight" phenomenon revisited
- Characteristics are **broad and indistinct** - except for one - adult bees are mysteriously gone. In 1985, Dr. Roger Morse wrote, 'It seems unlikely that any one cause produces all the losses are attributed to Disappearing Disease'
- Disease was **self-limiting** and **disappeared**

What's in a Name?

- Disappearing Disease
- Both bees and disease disappears
- Says nothing about the cause – only describes as symptom – Causes "broad and indistinct"
- Miscellaneous Disease – Jim Tew
- Dwindling Syndrome – H. Shimanuki
- Segue to Colony Collapse Disorder

History of Colony Collapse Disorder

- First appeared in 2006; large-scale losses, especially in large-scale beekeepers
- "Have We Seen This Before?" Underwood and van Englesdorp, 2007
- "Colony Collapse Disorder" (CCD) is a **new tag** name presently being given to a condition that is characterized by an unexplained rapid loss of a colony's adult population.

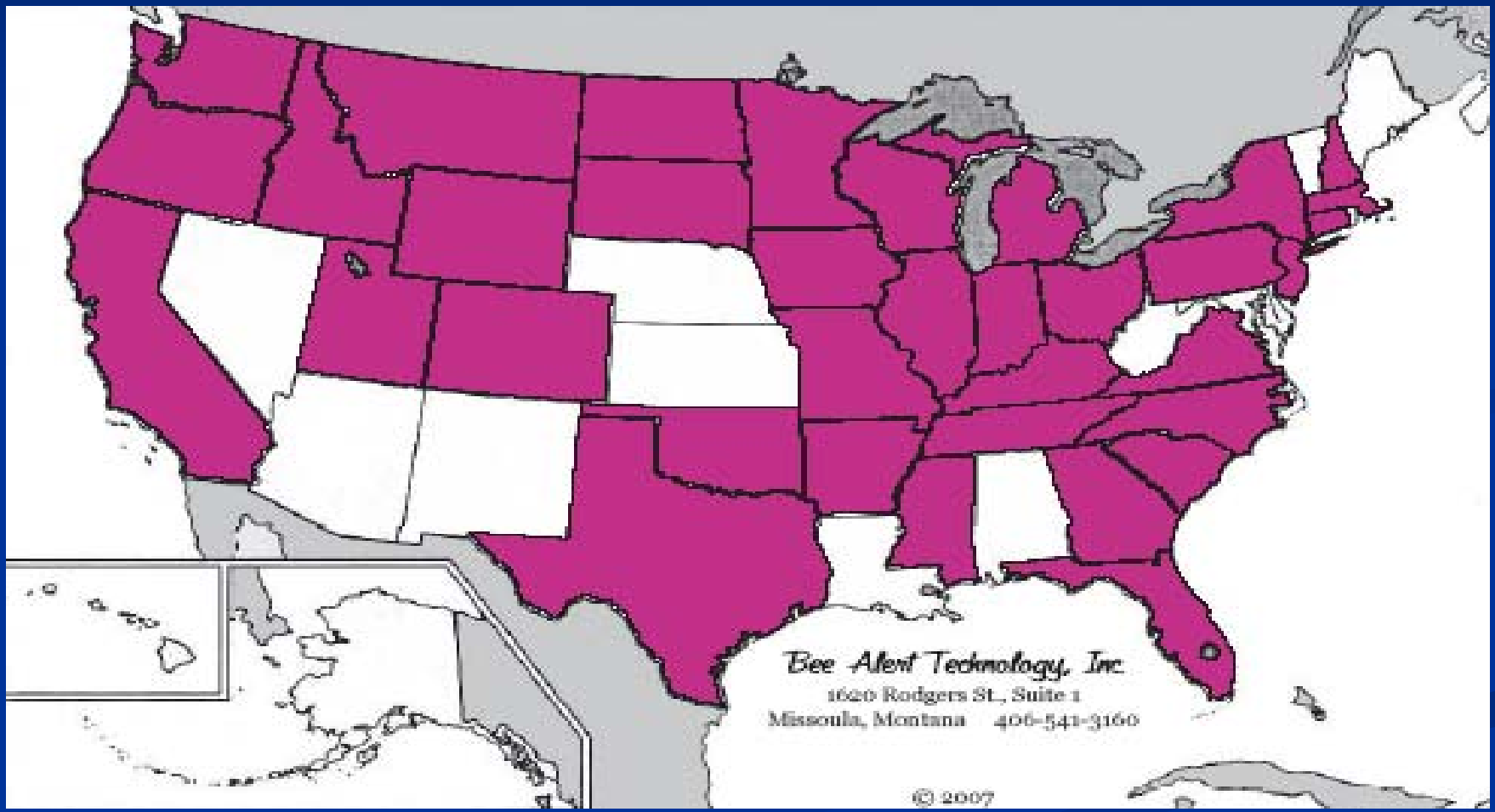
Symptoms of Colony Collapse Disorder

- **In collapsed colonies**
- complete absence of adult bees in colonies, with few or no dead bees in or around colonies
- presence of capped brood
- presence of food stores (both honey and bee bread) that are not robbed by other bees or typical colony pests (small hive beetles, wax moths, etc.). If robbed, the robbing is delayed by a number of days.

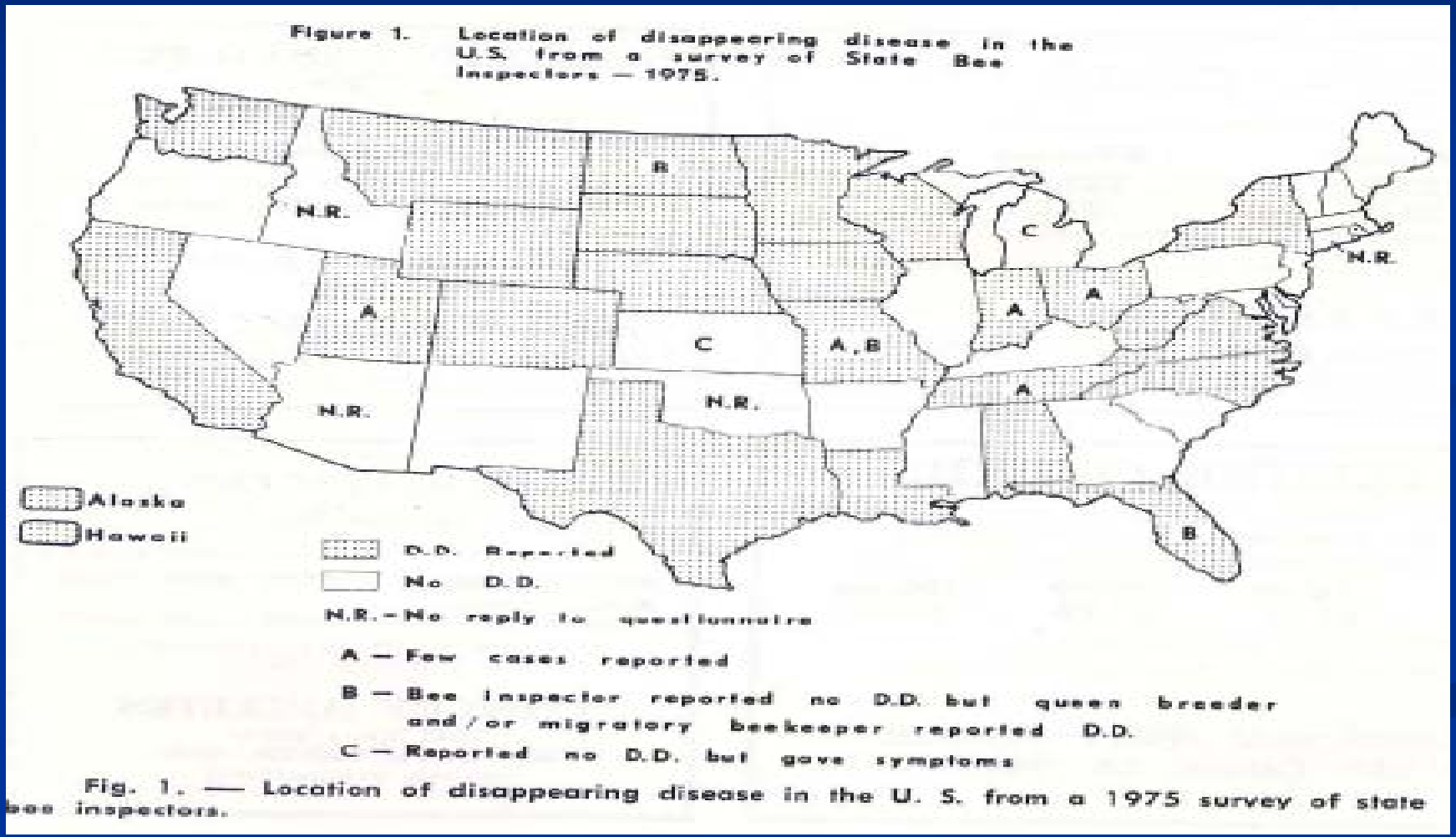
Symptoms of Colony Collapse Disorder

- **In collapsing colonies**
- insufficient number of bees to maintain the amount of brood in the colony
- workforce is composed largely of younger adult bees with queen is present
- cluster is reluctant to consume food provided to them by the beekeeper

Latest Survey CCD



Disappearing Disease 1975



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Advice to Beekeepers for CCD

- Do not combine colonies
- Do not reuse affected (infected?) equipment
- Feed for Nosema control
- Use Terramycin® not Tylan® for foulbrood control
- Use IPM for Varroa control
- Keep colonies strong!

Changes in Beekeeping

- Most beekeeping technologies developed in the 19th Century, including:
- Movable-Frame Hive
- Smoker, hive tool, suit, veil
- Extractor
- Foundation
- Feeding sugar

Changes in Beekeeping

- In the 20th Century, few new technologies only an "improvement" on efficiency
- Instrumental Insemination
- Transportation – trucks, interstate highways
- Feeding; high fructose corn syrup, 1977
- Feeding antibiotics for foulbrood, sulfa drugs 1940s replaced by Terramycin® 1960s
- Management shifts – honey production to commercial pollination

Challenges in Beekeeping Since 1984

- Tracheal mites 1984 – watershed year
- Varroa mites 1987
- How to control a mite on an insect?
- The pesticide – honey bee connection increases
- The further? domestication of the honey bee
- Small Hive Beetle 1996
- More exotics on the horizon?

In the Name of Efficiency

- Collected colonies into “apiaries”
- Equalized colonies
- Replaced queens
- Fed sugar and corn syrup
- Spread honey bees around the globe
- Poisoned colonies “collateral damage” in modern agriculture
- Transported colonies

In the Name of Efficiency

- Infested colonies with innate diseases (AFB)
- Forced bees to build nests on uniform cell sizes
- Split and united colonies
- Manipulated (examined) colonies
- Fed broad-spectrum antibiotics
- Purposefully applied pesticides (mite control)
- Exposed to new pesticide class (neonicotinoids)

Unintended Consequences

- Infested colonies with exotic organisms, *Acrapis*, Varroa, chalkbrood, *Nosema ceranae*, small hive beetle (*Aethina tumida*), viruses?
- Reduced the feral population, narrowing the genetic base, the basis for honey bee health
- Pollination comes to rely more and more on a single species – the honey bee
- A reduction in native ecotypes - homogenization

Unintended Consequences

- Chemical contamination of the brood nest and world beeswax supply
- Reduced effectiveness of the honey bee "immune system"
- Interactions among diseases (viruses), pesticides and environment (climate change)
- Others?

Educating Beekeepers

- The "old paradigm" is to look at human technologies that have improved "efficiency" and concentrate on them, not the bees.
- Bee biology has not been on the agenda of many beekeepers, especially large-scale ones that only "move boxes."
- The needs of the honey bee itself have been relegated to the sidelines: The root cause of CCD!

Jürgen Tautz, *The Buzz About Bees -Biology of a Superorganism*

"Our exploitation of natural systems without understanding them and their vulnerabilities in detail has disturbed fine balances, established over thousands of years." Fortunately, new ones will undoubtedly replace them, but unfortunately they may not be to our 'advantage.' "

Educating Beekeepers

- The "new paradigm" is to come to grips with a new population of beekeepers that must take beekeeping into the future
- Besides "commercial" and "hobby," we now must add "organic" and "sustainable" groups
- The question for the 21st Century: can the trainers change so their students will give honey bees a better chance to survive?

From Langstroth's *The Hive and the Honey Bee*

- Oettl's Golden Rule: KEEP YOUR STOCKS STRONG. "If you cannot succeed in doing this, the more money you invest in bees, the heavier will be your losses; while, if your stocks are strong, you will show that you are a *bee-master*, as well as a bee-keeper, and may safely calculate on generous returns from your industrious subjects."

Conclusion: Sustainability in Beekeeping

- How to reverse what humans have done to honey bees in the name of economic efficiency, by de-emphasizing the natural environment and the social nature of these insects
- A "systems" approach in the broadest sense
- "Interdisciplinary" research and extension: **bee health**— $4.1 million grant; 19 institutions
- Transition to sustainability is a "process"
- All participants needed, including the public

A Few Ideas to Start

- Treat colonies as if Varroa is an integral part of them; the fourth individual in the colony
- Study how standard manipulations really affect honey bee colonies
- Determine how environmental quality affects honey bees: The theme of Apimondia 2009 in Montpellier, France. (Climate change!)
- Get the public on board, a "teachable moment"