

# **Mega-Trends**

**In the Biological Sciences**

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# The obvious one...

- **Biotechnology**
- **This is an on-going “mega-trend”**
- **Crops genetically engineered for resistance to herbicides and insect pests are just a couple of already implemented examples**

QuickTime™ and a  
TIFF (Uncompressed) decompressor  
are needed to see this picture.

# **Biotech requires an understanding of...**

- **Biology, genetics, biochemistry, agronomy, plant pathology, entomology, etc.**
- **As well as mathematics, statistics, chemistry, business, etc.**
- **And relates directly to all 5 College of Ag student outcomes (Communication, Critical Thinking, Ethics, Environmental Awareness, and International/Multi-Cultural Awareness)**

# Increased Extinction Rates and loss of Biodiversity - An “emerging” Mega-Trend

- This trend has particular relevance to agriculture in that much of the immediate goal of agriculture is **MINIMIZING** biodiversity (e.g., only **corn** in your **corn** field...)

**E.O. Wilson**  
***(The Diversity of Life)***  
**1992**

**“Our species appropriates 20-40% of the solar energy captured by land plants. There is no way we can draw upon the resources of the planet to such a degree without drastically reducing the state of most other species.”**

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# **Human Impacts on Extinction Rates**

- **Worldwide, species are estimated to be going extinct at a rate ~ 50X greater than at any point in the last 100,000 years**
- **In Tropical Rain Forests extinction rates are estimated to be 1,000 to 10,000 greater than “normal”**

- **Agriculture is, of course, not the **only** cause of increased rates of extinction**
- **But, it is very likely to be a significant cause in many contexts**

**Has this happened here  
in Iowa?**



# Freshwater Mussels

- Iowa has lost 28 (50%) of its 55 species of mussels since ~ 1900
- Of the remaining 27 species, 14 are listed as threatened or endangered
- Mussels are currently quite uncommon in our local streams



# *Amblema plicata* (Three-ridge Mussel)

- We've found many dead shells in the Skunk River and Squaw Creek, but have never seen a live one



# *Lampsilis higginsii* (Higgins Eye mussel)

- Listed as “endangered” in Iowa
- Restoration efforts are underway, but unclear whether they will be successful

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# What happened to our mussels?

- In a word - “dirt”, i.e., dramatically increased sedimentation in our streams
- A major cause of increased sedimentation is agricultural practices
- Farmers certainly weren’t “trying” to decrease our mussel diversity - but their actions had that effect

# How much biodiversity is there?

- Way more than you might imagine
- About 1.5 million species have been named
- Current estimates are that this is only **5 to 30%** of the total number of species on Planet Earth
- Many species may have already gone extinct without ever being named or investigated for useful properties

# Who Cares?

- Earth's biodiversity is a “treasure” that should not be squandered for short-term gain
- Biodiversity may provide us with economically useful resources that we are, as yet, unaware of
- Is it “ethical” for us to cause the extinction of **any** other species?



# The Challenge

- The goal for agriculture (as I see it) should be to **maximize** agricultural production in those portions of the landscape we choose to dedicate to agriculture, while at the same time **minimizing** the impacts of agriculture on biodiversity in portions of the landscape not dedicated to agriculture

# Meeting the challenge

- A clear intersection here with one of the College of Ag student outcomes: “Environmental Awareness”
- Ag students (and everyone else too, for that matter) need to attain a deeper understanding of what biodiversity is and why it’s so valuable



- **Increased implementation of practices designed to minimize off-site impacts of agriculture, e.g., “buffer strips” along streams, wetlands used for denitrification of tile water, best practices to minimize soil erosion, responsible manure management, minimized use of toxic chemicals and fertilizers, etc.**

# **Bioinformatics - A Rapidly Developing Mega-Trend**

- **A “marriage” of biology, mathematics, statistics and computer science**
- **Commonly involves analysis of DNA or protein sequences and their structures**
- **Can also be used to estimate biodiversity**

# **NIH Definition of Bioinformatics**

- **Research, development, or application of computational tools and approaches for expanding the use of biological, medical, behavioral or health data, including those to acquire, store, organize, archive, analyze, or visualize such data.**

- **Currently have a Bioinformatics and Computational Biology (BCB) interdepartmental graduate major**
- **An undergraduate major in BCB is being developed**