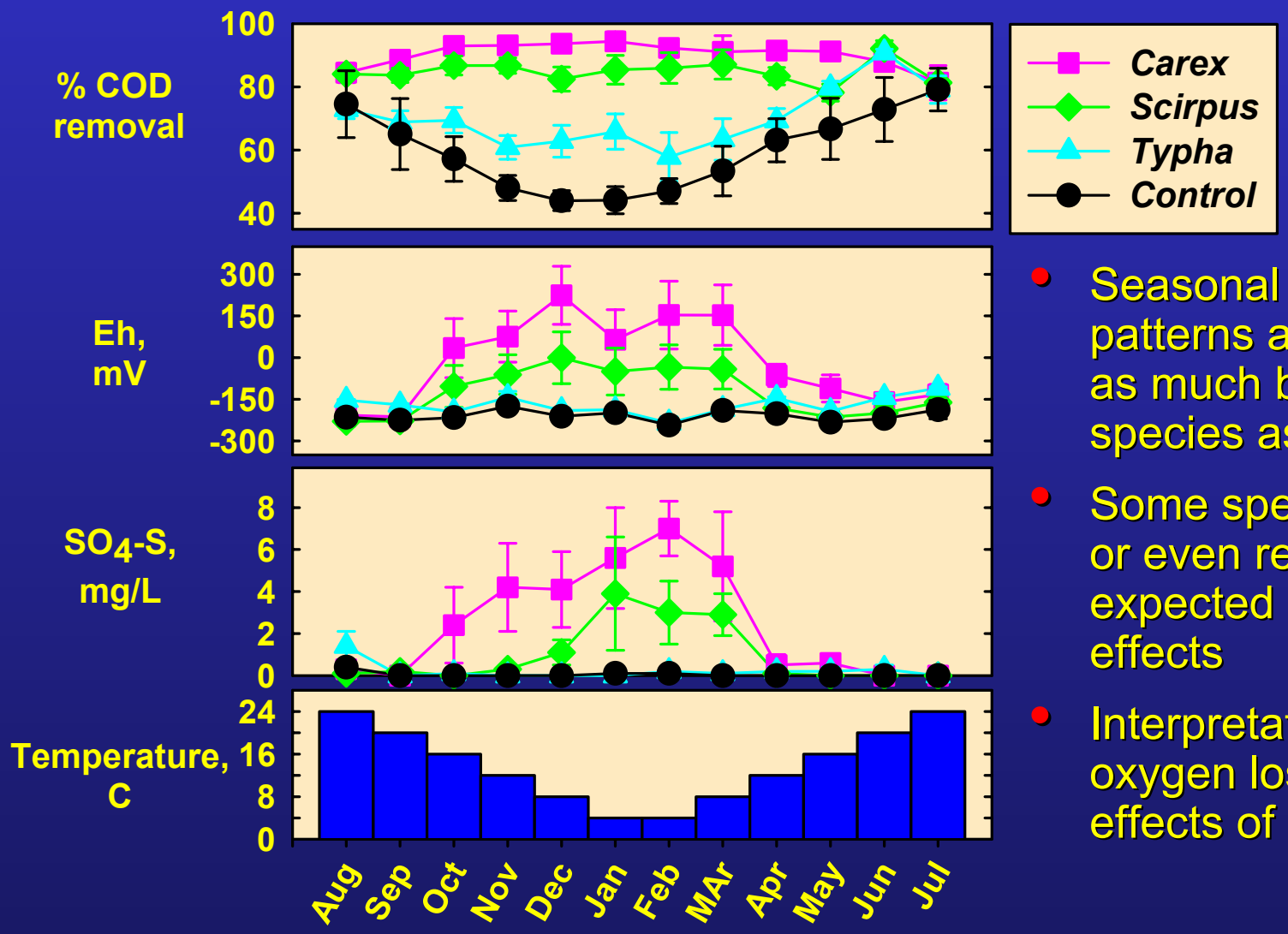
Constructed wetlands are used to treat agricultural and urban NPS runoff, feedlot runoff, and domestic and municipal wastewater

Significant research gaps:

- cold region design and operation
- plant species effects and selection
- rhizosphere microbial dynamics
- optimizing hydraulic operations

Previous results: seasonal Patterns of CW performance for three plant species



- Seasonal treatment patterns are controlled as much by plant species as temperature
- Some species negate – or even reverse – expected temperature effects
- Interpretation: root oxygen loss offsets effects of cold

From Hook et al. 2003

Objective 1: Understand the basis of plant species effects on wastewater treatment

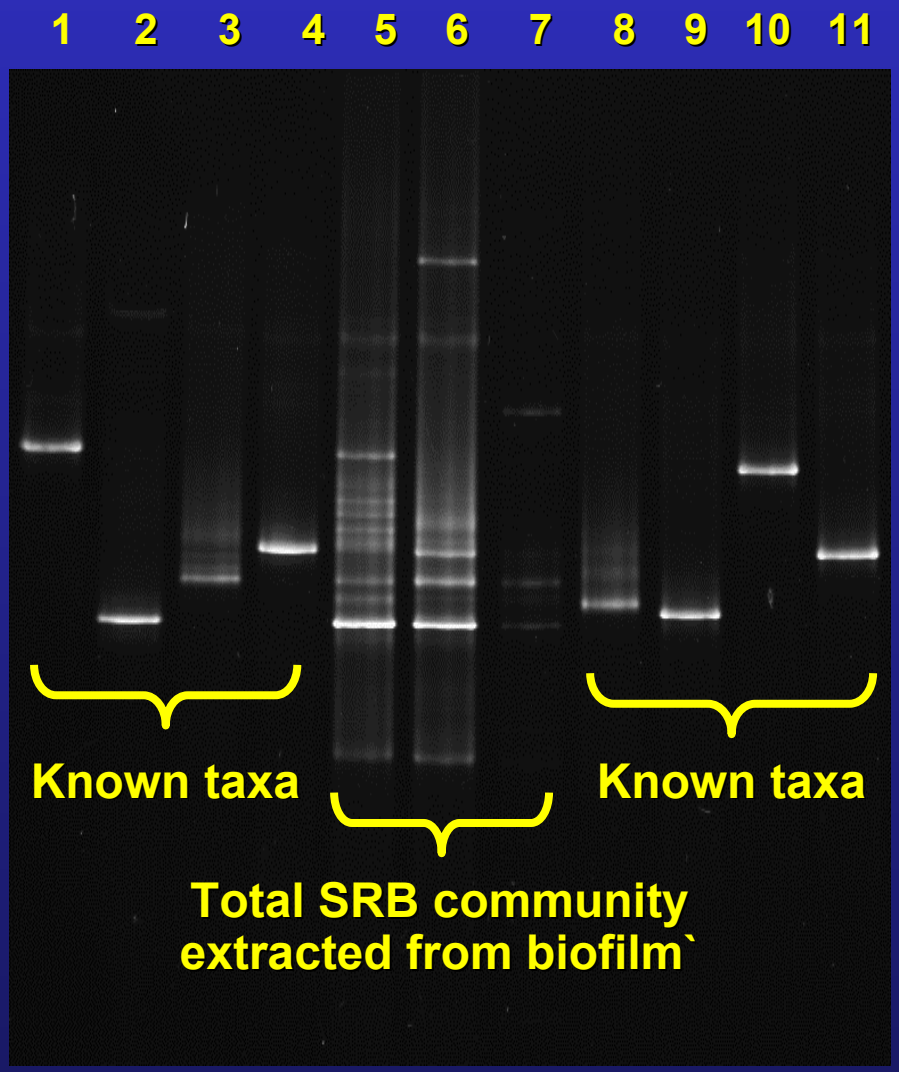
Evaluate contrasting wetland species for relationships among:

- wastewater treatment performance
- oxygen release from roots
- flooding tolerance

- 19 plant species and unplanted control
- Range of association with wetlands
- Focus on untested natives and widely used CW species

Species	Wetland Indicator Rank
Typha latifolia	10
Carex rostrata/utriculata	10
Carex aquatilis	10
Carex nebrascensis	10
Carex bebbii	10
Scirpus acutus	10
Iris missouriensis	9
Calamagrostis canadensis	9
Phalaris arundinacea	8.5
Phragmites australis	8.5
Carex praegracilis	8
Juncus balticus	8
Juncus torreyi	8
Deschampsia cespitosa	8
Hordeum jubatum	6
Carex microptera	5.5
Panicum virgatum	5
Leymus cinereus	5
Prunella vulgaris	5

Objective 2: Understand the role of varying microbial communities and activity on wastewater treatment



Example: Sulfate Reducing Bacteria

- PCR-DGGE with primers specific for the sulfite reductase gene
- PCR products sequenced
- Four SRB species isolated

Next steps

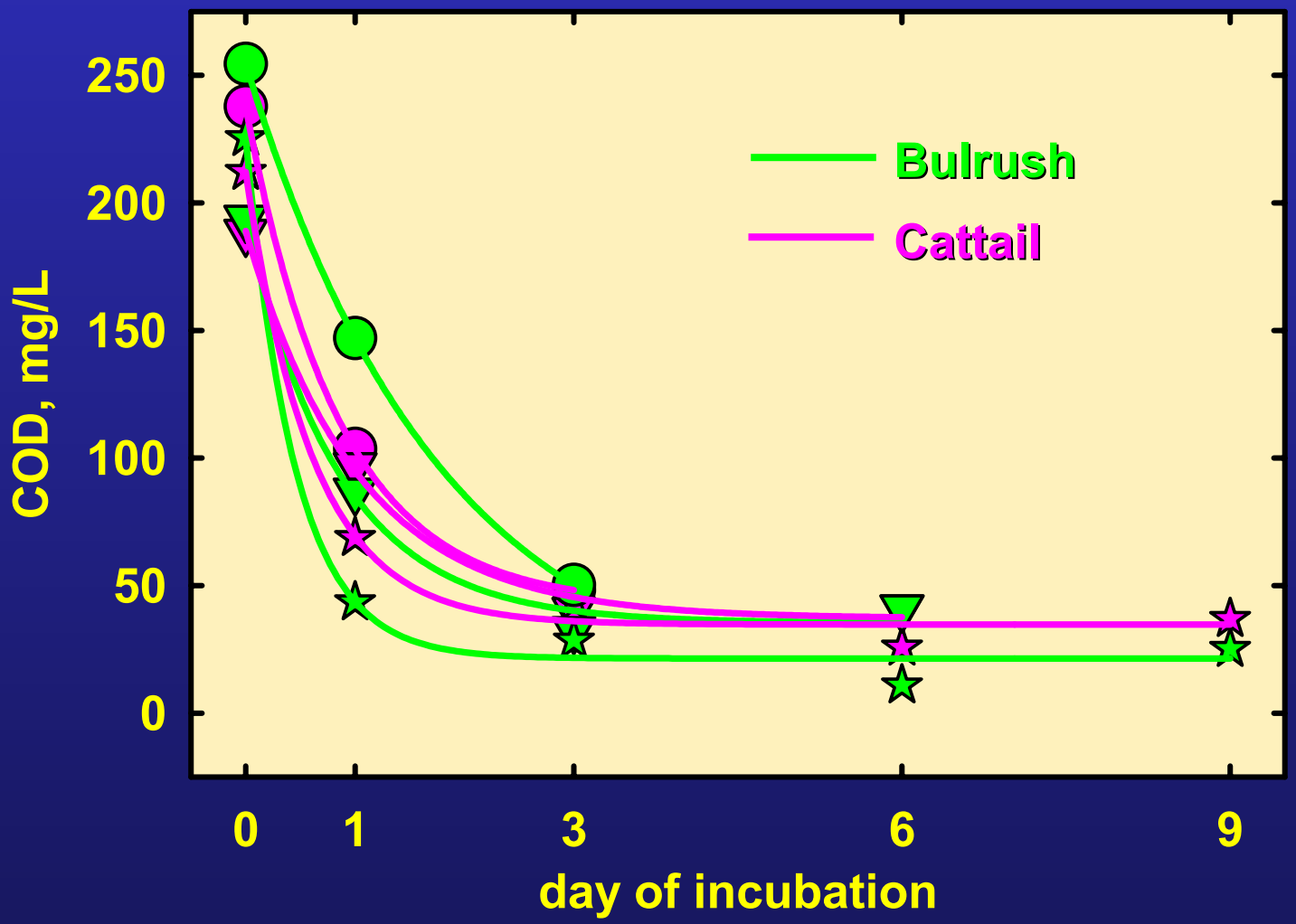
- Use DNA markers specific to different functional groups to evaluate responses of rhizosphere microbes to:
  - plant species
  - root age and position
  - organic carbon loading
  - season and temperature

Objective 3: Evaluate effects of different modes of hydraulic operation on wastewater treatment

- Batch loading versus continuous flow
- Batch length
- Effects of operation on root-zone oxidation, temperature response, and seasonal CW performance

Initial results

- Short batch lengths are as effective as long ones at 24°C
- One annual cycle will be finished in February 2007



Outputs and impacts under NRI and other support

- Contributions to understanding effects of temperature, seasons and plants in cold region CWs
- Extensive presentation, publication, and collaboration
- 10 graduate students supported
- Working to apply results, ease regulatory hurdles, and revise design standards in Montana and Idaho