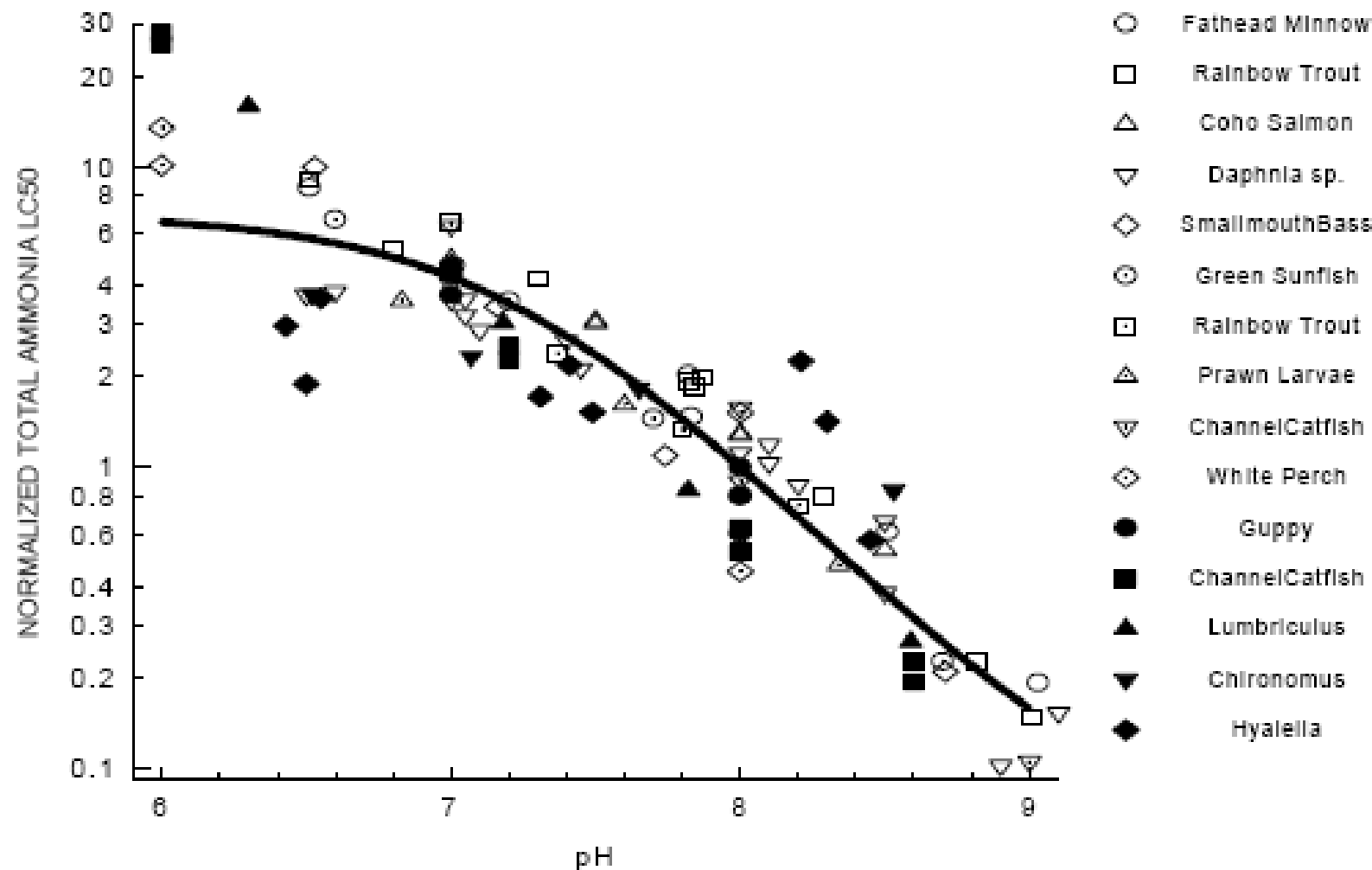


# **Important Considerations for Ammonia Toxicity**

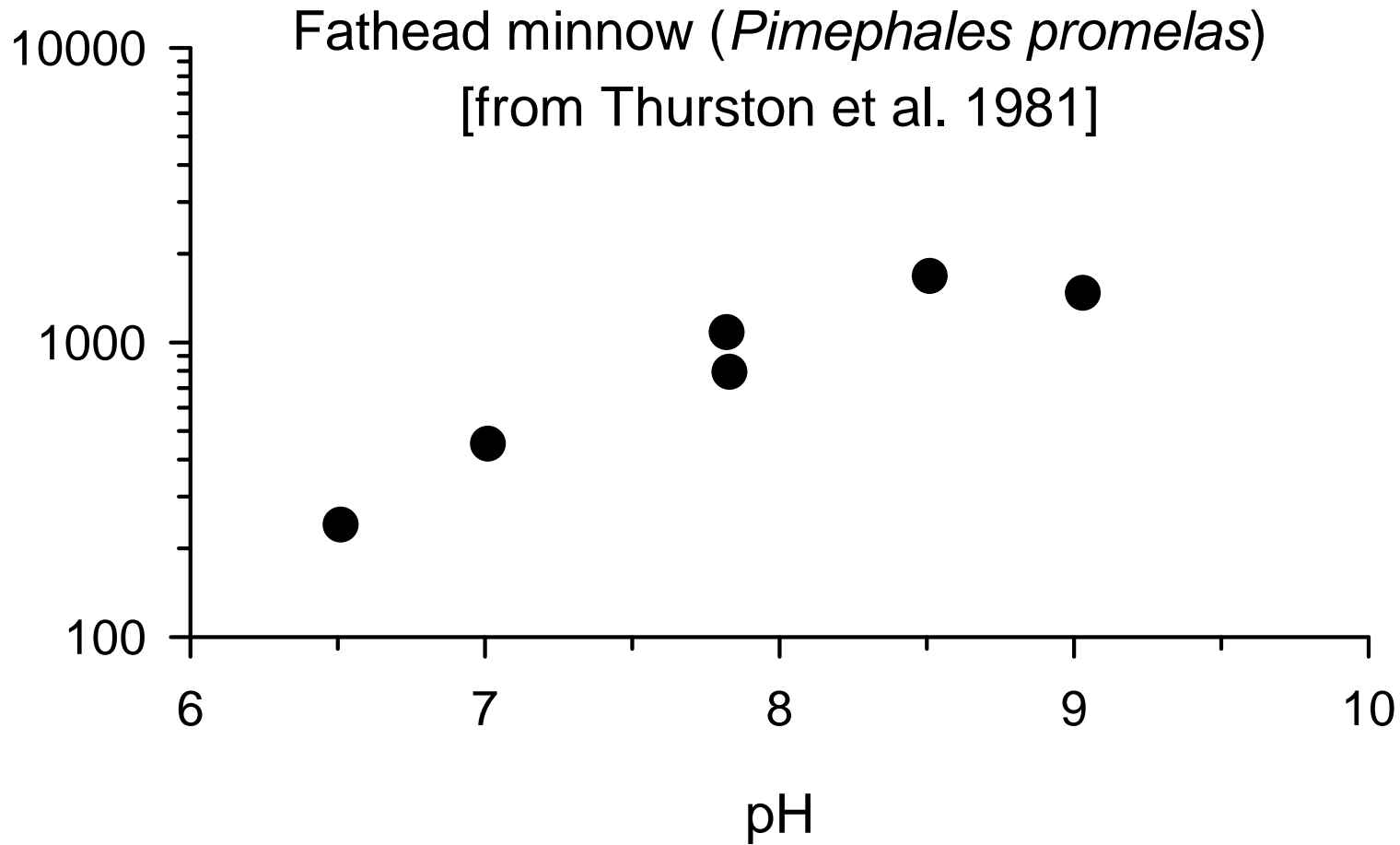
- **pH dependence has two components:**
  - **Chemical speciation**
  - **Biological response**
  
- **Sensitive freshwater mussels will be added to USEPA criteria for ammonia**  
**⇒ criteria will be lowered, where applicable**

Figure 9. The effect of pH on normalized acute ammonia toxicity in terms of total ammonia. Data were normalized by dividing measured LC50s by regression estimates of LC50s at pH=8 for individual datasets from Figure 8. Data were not normalized in any way for temperature.

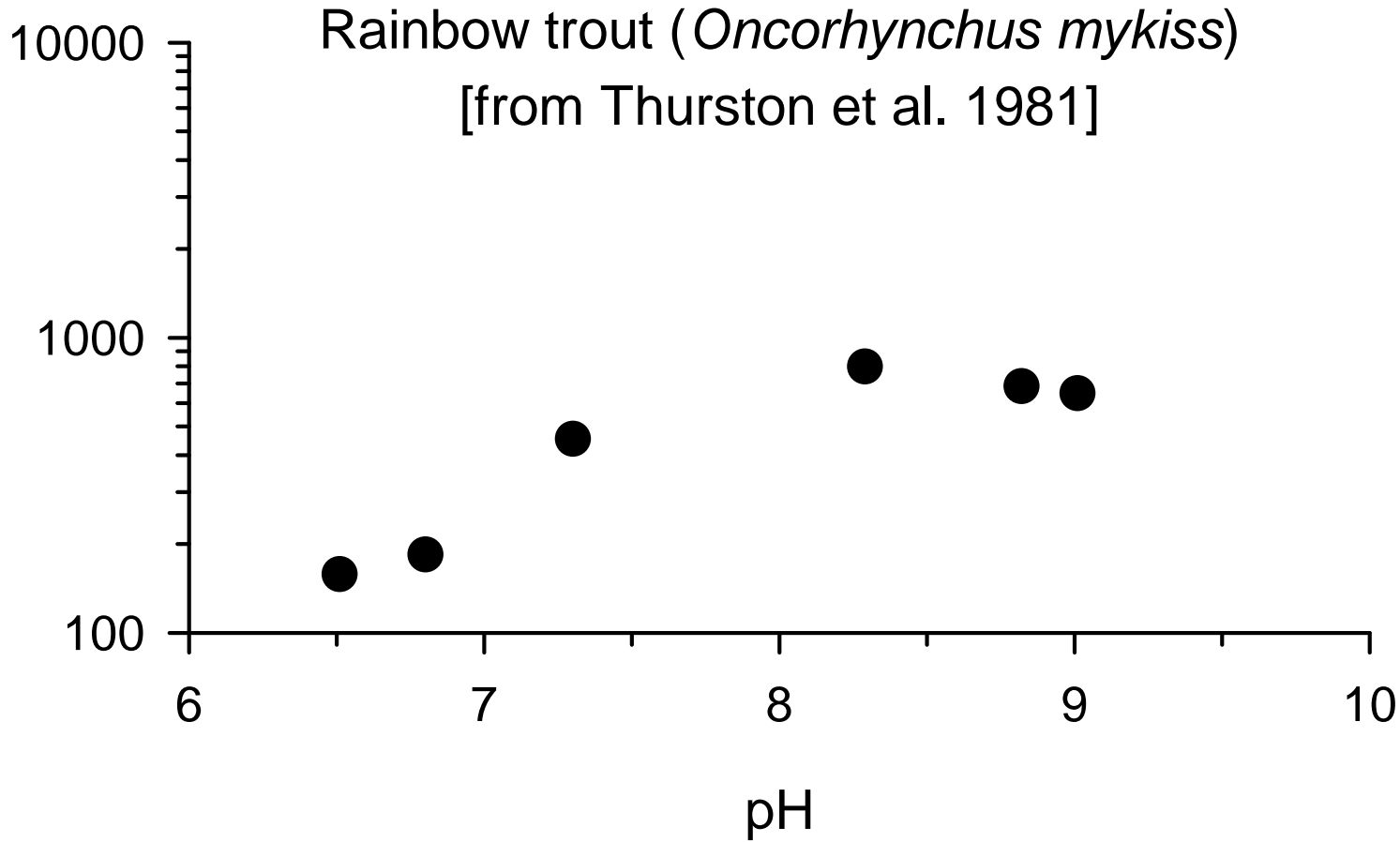


From USEPA (1999)

Un-ionized ammonia LC50  
( $\mu\text{g NH}_3/\text{L}$ )



Un-ionized ammonia LC50  
( $\mu\text{g NH}_3/\text{L}$ )



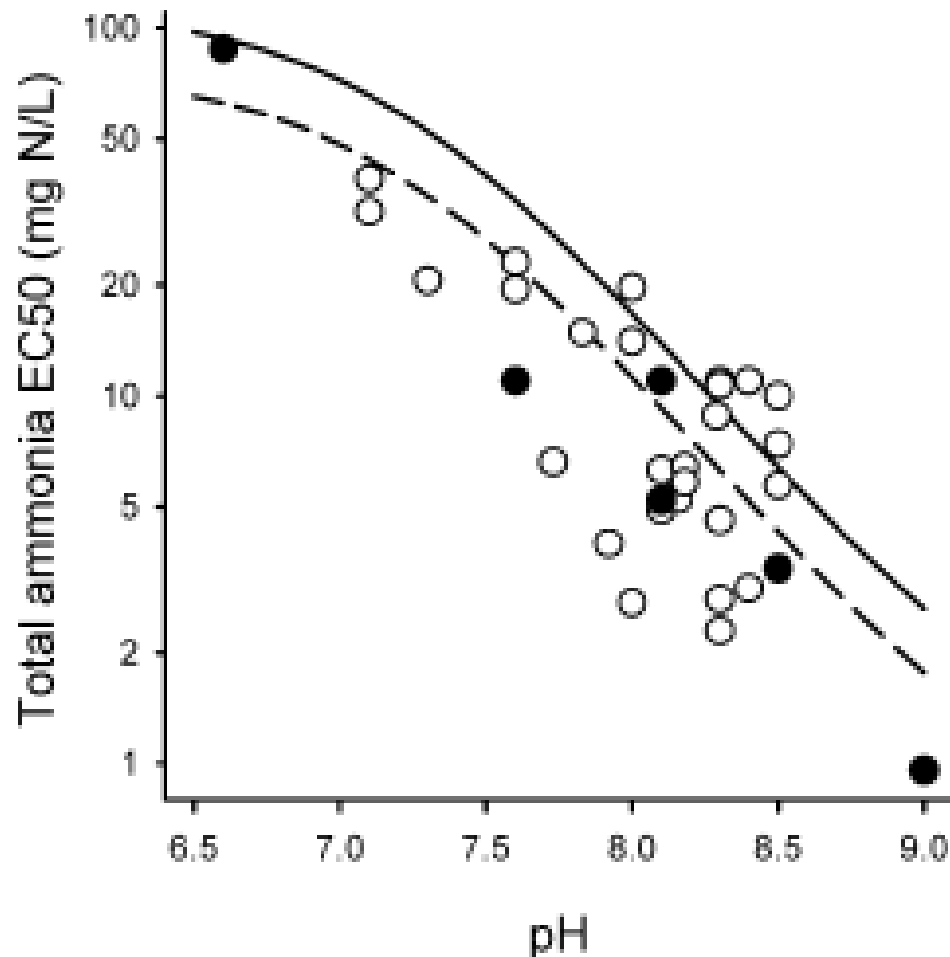
# Appropriate Normalization

- **Plot toxicity units (TU), not absolute concentration of total ammonia or un-ionized ammonia**

$$\text{TU} = \text{Conc.} / \text{LC50 @ pH, T, S}$$

or

$$\text{TU} = \text{Conc.} / \text{criterion @ pH, T, S}$$



From Wang et al. (2008)  
 ET&C 27:1141-1146

Fig. 2. Comparison of median effective concentrations (EC50s) for total ammonia at various pH levels in the present study with juvenile mussels (fatmucket, *Lampsilis siliquoides*; ●) and in other studies with juveniles of 11 mussel species (○; species names and references of the previous studies are listed in Table S3) to final acute values in the U.S. Environmental Protection Agency water quality criteria for ammonia [1] with (---) and without (—) protection for the presence of salmonid fish.