

ENDOCRINE DISRUPTION



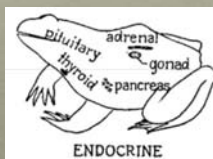
Bryan Dickey

LECTURE OUTLINE

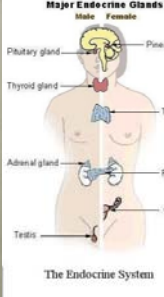
- Define the endocrine system
- Importance of the endocrine system
- Causes of endocrine disruption
- Research linking endocrine disruptions to amphibian declines
- Summary of the overall impact

ENDOCRINE SYSTEM

- System of glands that excrete hormones
- Major secreting glands include the Thyroid, Pituitary, Adrenal, Pancreas, Testicles and Ovaries



ENDOCRINE SYSTEM



Major Endocrine Glands	Gland	Hormones produced	Effect of Hormone
Pituitary gland	Pituitary gland	Growth hormone	Affects reproductive development and daily physiological cycles
Pineal gland	Pineal gland	Melatonin	Controls growth of bones and muscles
Thyroid gland	Thyroid gland	Thyroxine	Controls development of organs and testes
Adrenal gland	Adrenal gland	Adrenaline	Controls rate of metabolism and rate that glucose is used up in respiration, and promotes growth
Pancreas	Pancreas	Insulin	Prepares the body for emergency increases heart rate and rate and depth of breathing, raises blood sugar level as more glucose is available for respiration, diverts blood from gut to limbs
Ovary	Ovary	Oestrogen	Controls ovulation and secondary sexual characteristics
Testis	Testis	Testosterone	Prepares the ovum for fertilisation, promotes production and maturation of white blood cells

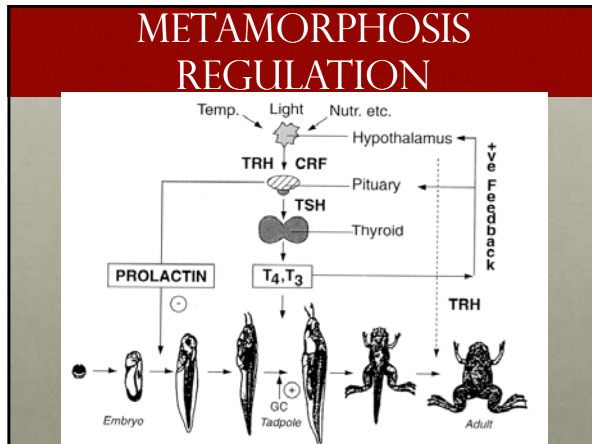
IMPORTANCE OF ENDOCRINE SYSTEM

- Extremely important during metamorphosis
 - Thyroid gland excretes thyroxine, which controls metamorphosis
- In addition to the effect on metamorphosis, the endocrine system also:
 - Aids in reproduction
 - Promotes post-metamorphic growth
 - Develops T-cells for the adaptive immune system

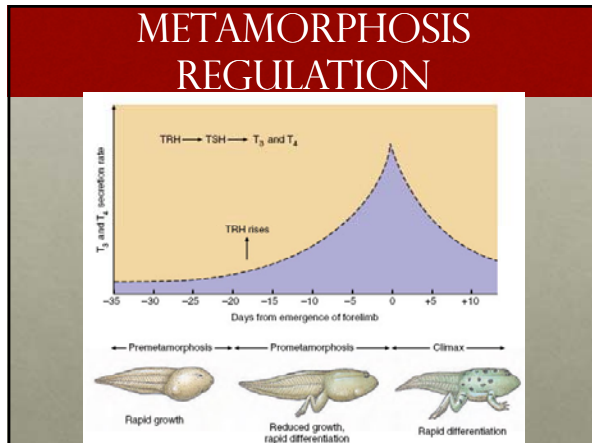
METAMORPHOSIS REGULATION

- Tata et al. 1998 article titled: *Amphibian metamorphosis as a model for studying the developmental actions of thyroid hormone*
- Thyroxine and triiodothyronine are hormones secreted from thyroid gland
- Thyroid secretions controlled by the pituitary gland
- Pituitary secretions controlled by hypothalamus

METAMORPHOSIS REGULATION




METAMORPHOSIS REGULATION

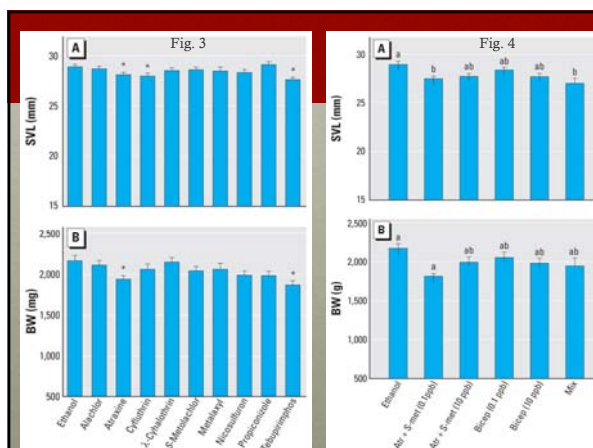
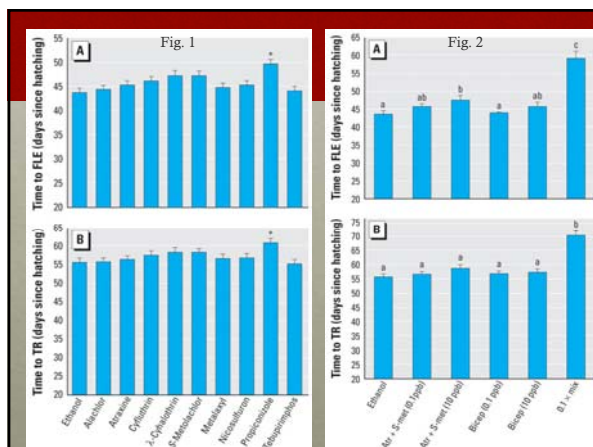


CAUSES OF ENDOCRINE DISRUPTION

- Caused by chemical contaminants in the environment
- Majority of these contaminants are pesticides:
 - Herbicides
 - Insecticides
 - Fungicides

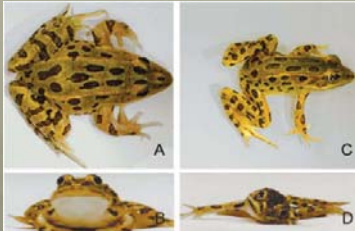
EVIDENCE

- Hayes, T. B. *et al.* (2006) study in Nebraska
 - Objective:
 - Determine the effects of realistic pesticide mixtures applied to cornfields in York County, Nebraska
 - Experiment:
 - Examine effects of 9 pesticides (4 herbicides, 3 insecticides, and 2 fungicides) alone or in combination on northern leopard frogs (*Rana pipiens*)
 - Separately examined effects of atrazine + S-metolachlor mixture and Bicep II Magnum (commercial mixture) because these are consistently present in the environment
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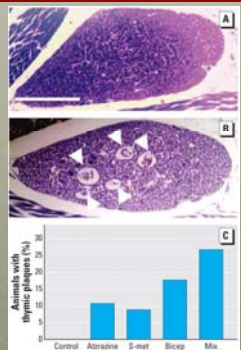
RESULTS

- 70% of specimens exposed to the 9 pesticide mixture could not sit-up right due to infection from a *Flavobacterium* (*Chryseobacterium meningosepticum*)



RESULTS

- Thymic plaques lead to reduced Thymic gland production of T-cells needed to fight disease
- As a result many frogs were susceptible to this flavobacterium

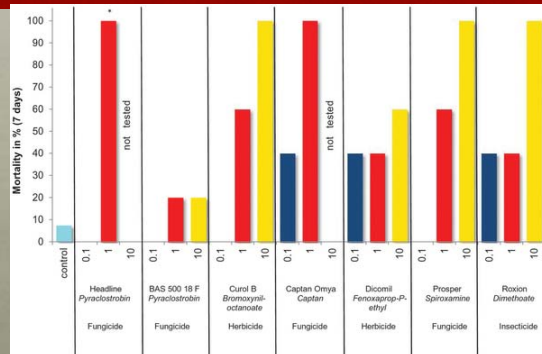


MORE EVIDENCE

- Bruhl, C. A. *et al.* (2013) conducted a similar study
- Looked at mortality rates of 7 pesticides (4 fungicides, 2 herbicides, and one insecticide) on juvenile European common frogs (*Rana temporaria*)
- Applied the pesticides to soil at 3 different rates: 0.1x recommended application rate, the recommended rate, and 10x the recommended rate



RESULTS



SUMMARY

- Endocrine disrupting chemicals are regularly found in the environment
- By disrupting the endocrine system, amphibians have a reduced chance to make it through metamorphosis
- Even if they do survive to adults/juveniles, they will be much smaller in size increasing their chance to be preyed upon
- Amphibians that are exposed to endocrine disrupting chemicals will be more sensitive to diseases

SUMMARY

- Unlike birds and mammals, for amphibians no risk assessment is required for the registration of a new pesticide
- Finally, amphibians are especially sensitive to endocrine disrupting chemicals because they have highly permeable skin and the majority of them reproduce and pass through critical hormone-regulated developmental stages while in an aquatic environment

REFERENCES

- Hayes, T. B. *et al.* Pesticide mixtures, endocrine disruption, and amphibian declines: Are we underestimating the impact? *Environmental Health Perspective* 114, 40-50 (2006)
- Bruhl, C. A. *et al.* Terrestrial pesticide exposure of amphibians: An underestimated cause of global decline? *Scientific Reports* 3, 1135 (2013).
- Tata, J. R. *et al.* Amphibian metamorphosis as a model for studying the developmental actions of thyroid hormone. *Biochimie* 81, 359-366 (1998).
- Thyroid Hormones section of Biocyclopedia.com
- Several pictures from google images

QUESTIONS?