

# Evaluation of endocrine disruption in sea bass (*Dicentrarchus labrax*) :

Effects of persistent organic  
pollutants on their thyroid  
function

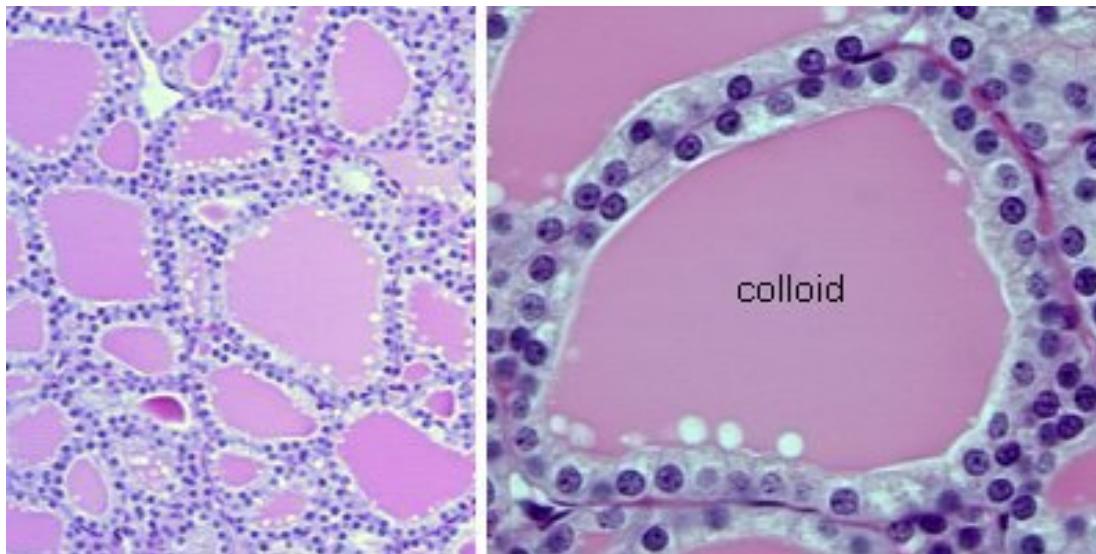
• Joseph Schnitzler

# The thyroid

- ◆ Many aspects of **thyroid endocrinology** are very well conserved across vertebrate taxa.
- ◆ These aspects include
  - ◆ thyroid hormone chemistry,
  - ◆ synthesis,
  - ◆ transport,
  - ◆ regulation.
- ◆ Same **proteins involved** in these processes

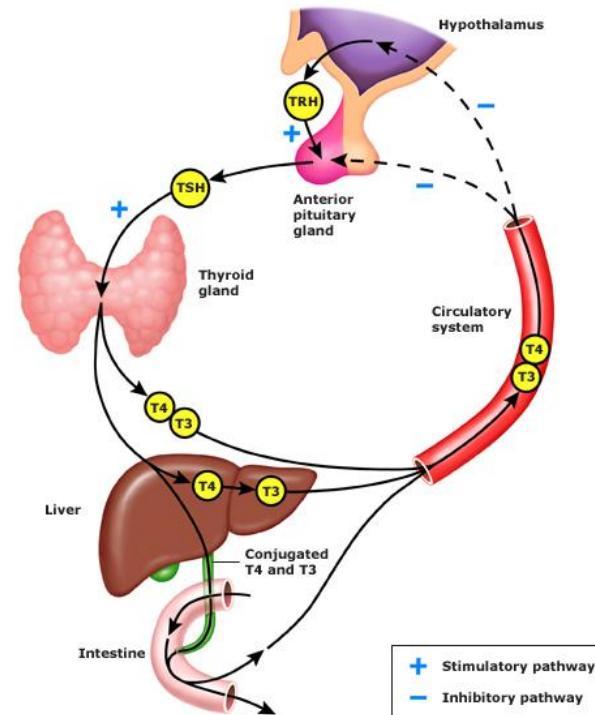
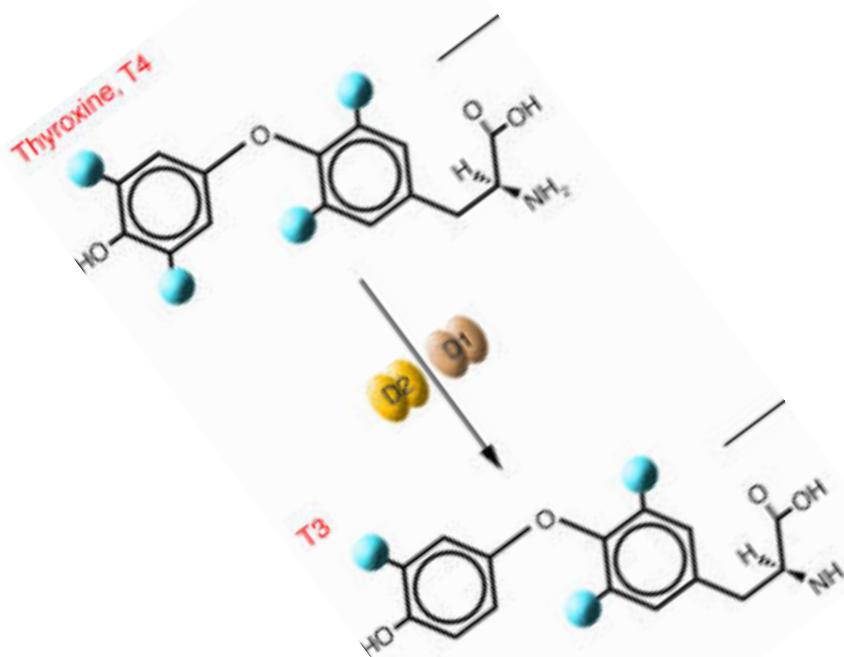
# Synthesis

- Special functional anatomy: Thyroid epithelial cells are arranged in spheres called **thyroid follicles**. Follicles are filled with **colloid**, a proteinaceous depot of thyroid hormone precursor.

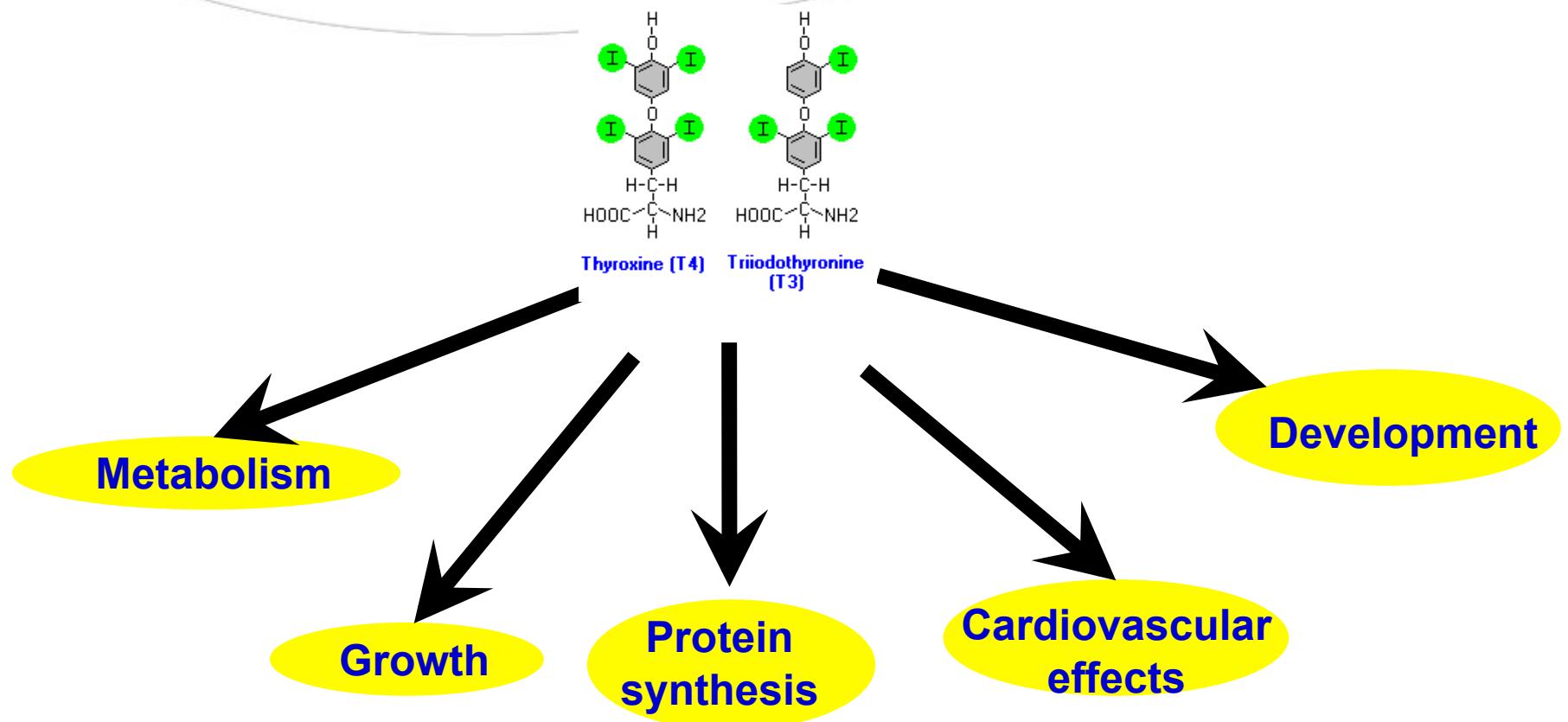


# Metabolism

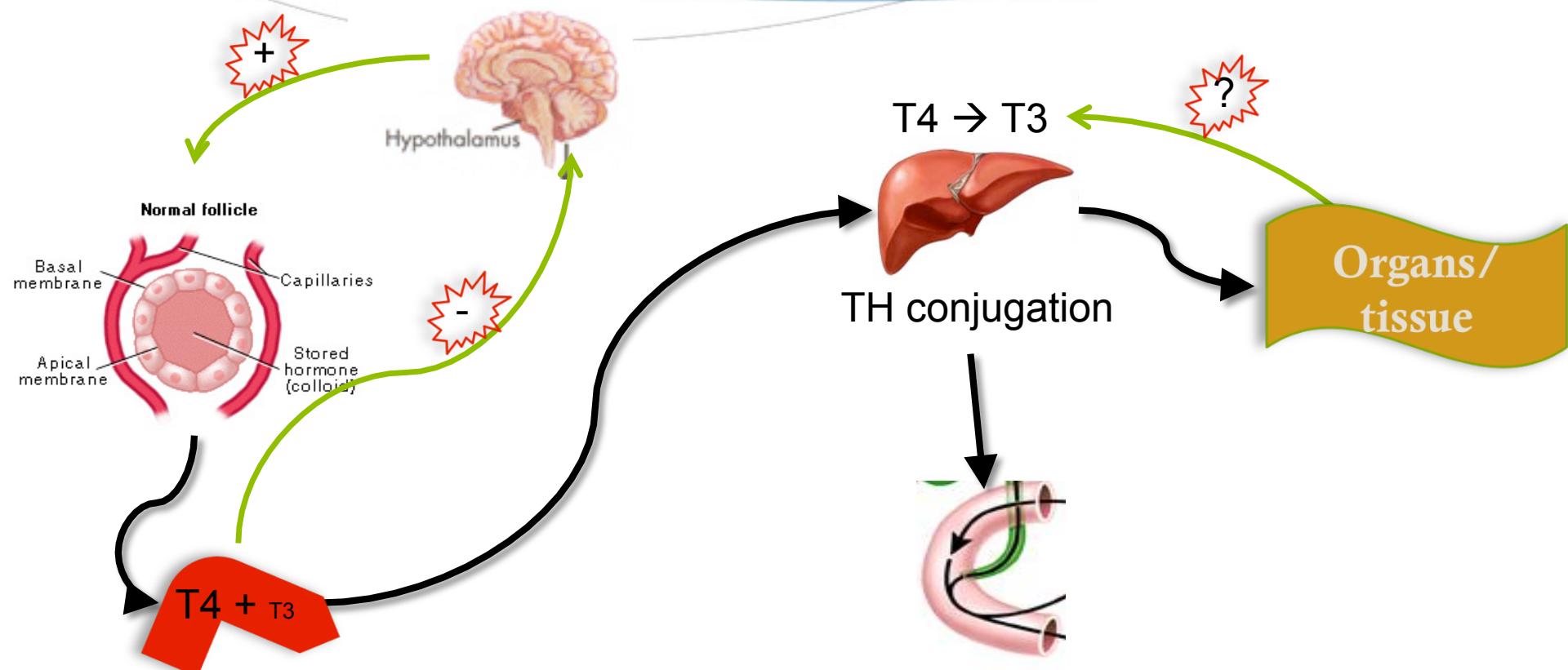
- Secrete a prohormone: which has to be metabolized by specific enzymes deiodinases.



# Thyroid hormones play a crucial role in:



# Regulation



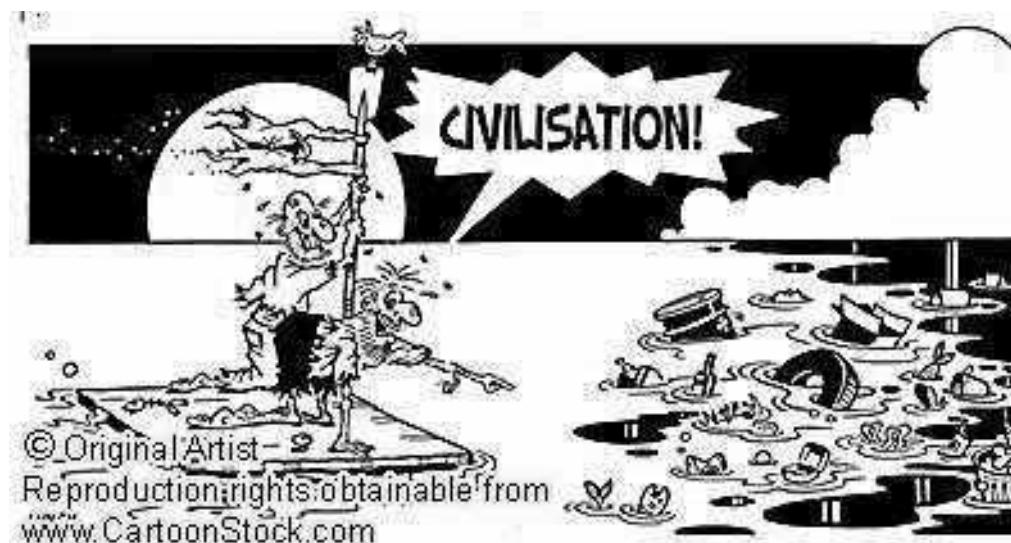
$T4 \rightarrow$  Centrally controlled  
hypothalamus-pituitary-thyroid axis

$T3 \rightarrow$  Peripheral control in extra-thyroidal tissues

# Endocrine disruptors

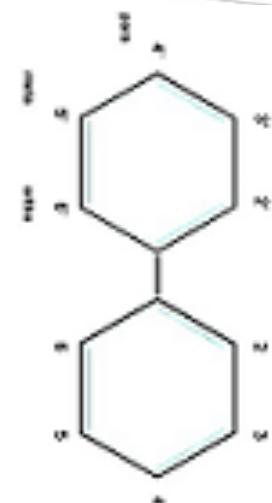
Endocrine disruptors:

- synthetic chemicals
- mimic or block hormones
- disrupt hormone function

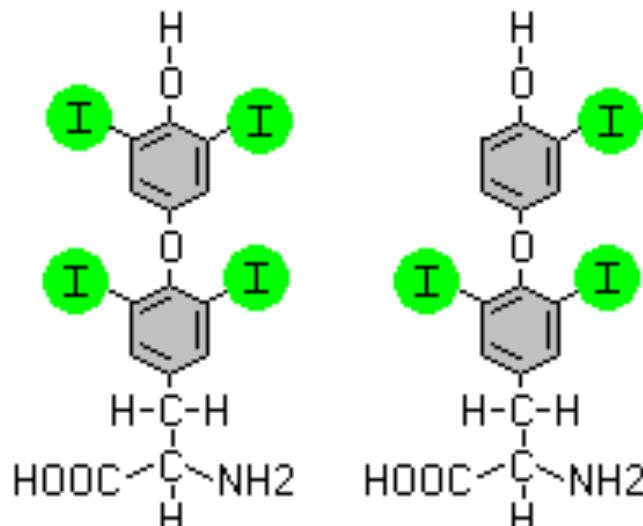


→ Sea as “final sink” for pollution contains high concentrations of endocrine disruption chemicals

# Organochlorinated pollutants



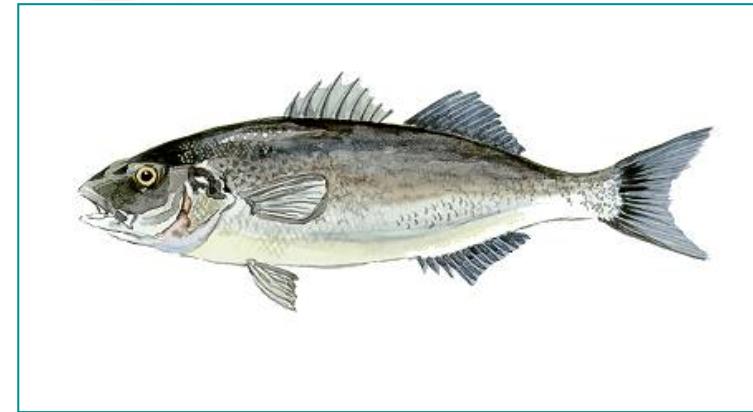
Polychlorobiphenyls (PCBs)



Thyroxine (T4)      Triiodothyronine (T3)

- similar structures as thyroid hormones
- may generate an endocrine disruption

# Sea bass (*Dicentrarchus labrax*)



- easily accessible, large distribution and relatively abundant
- optimal size
- long lived animals at the top of the food web
- sedentary habits



**Perfect for sentinel species**

# Aims of this study

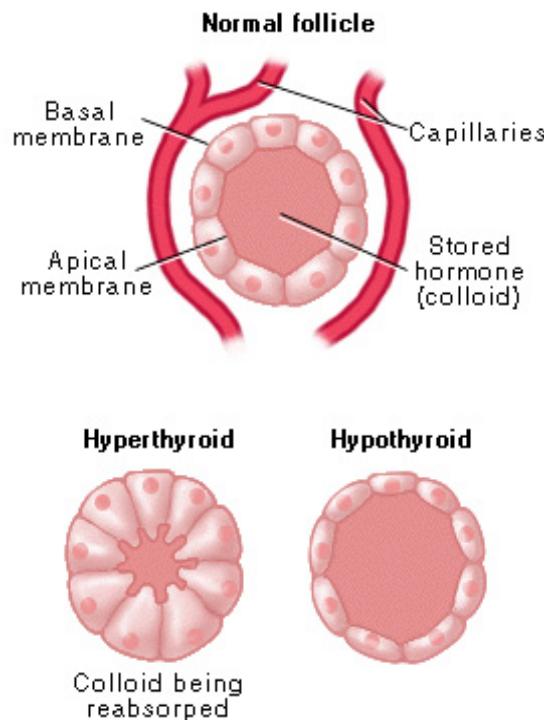
- Evaluate the potential effect of environmental pollutants on the thyroid function using simultaneously different thyroid parameters
- Study the underlying mechanisms and effects of such an endocrine disruption

# Experimental part



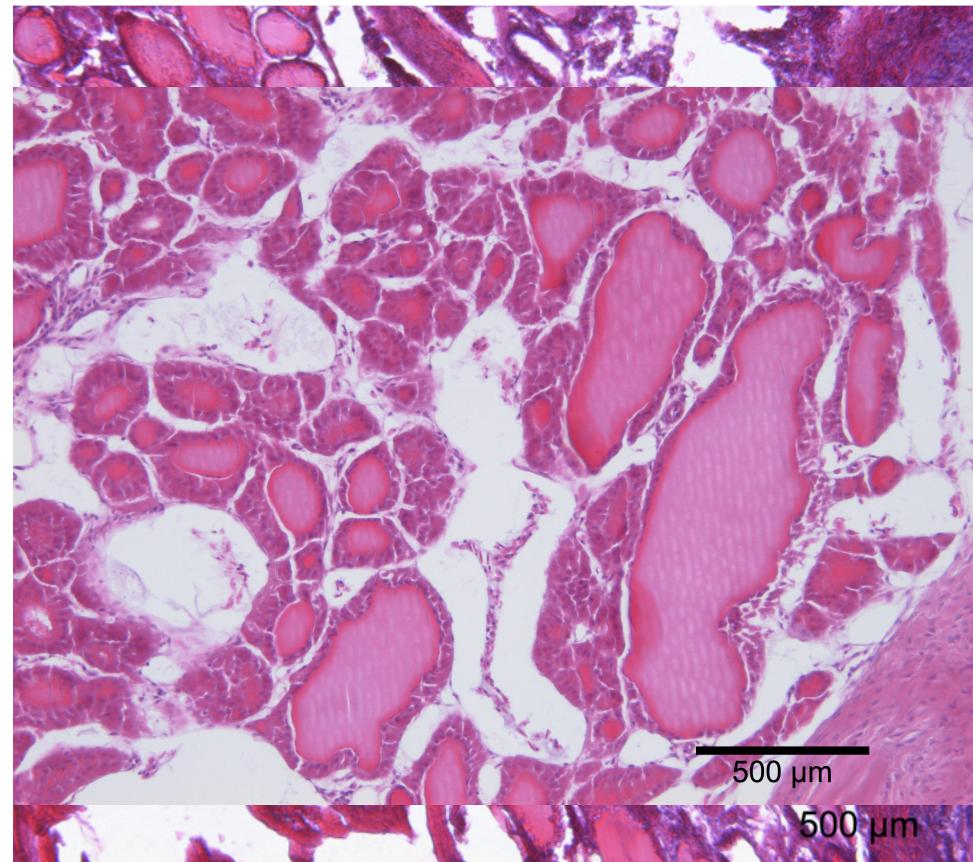
# Thyroid parameters

- In order to examine all facets of fish thyroid function, we propose to study simultaneously different endpoints

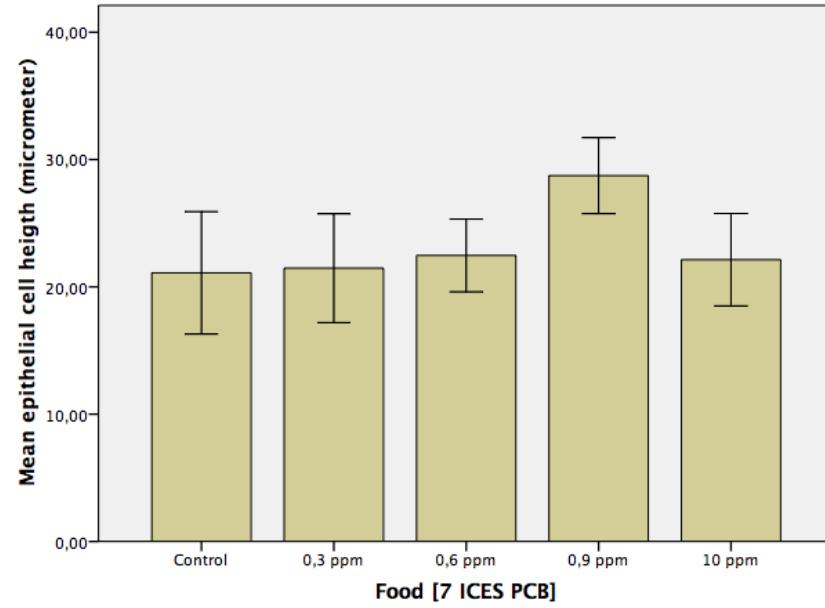
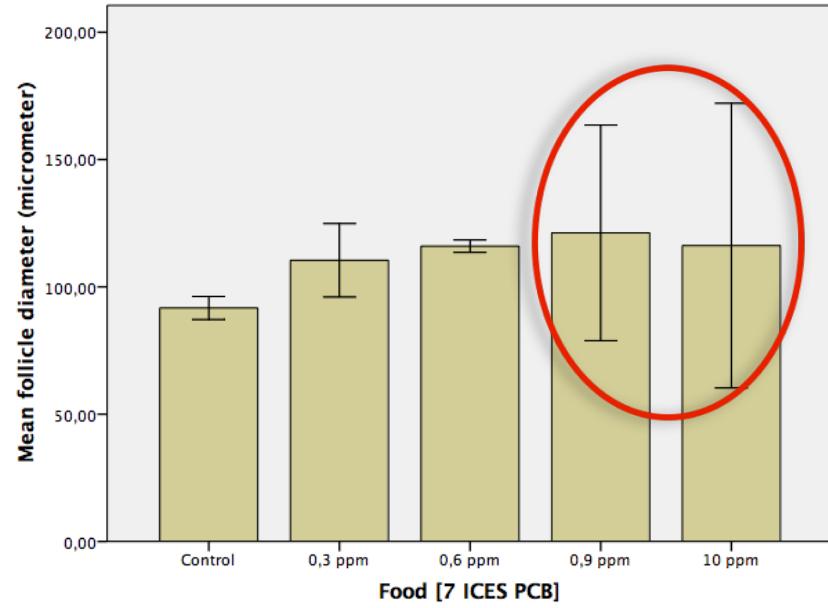


# Thyroid Histology

- Follicles dispersed on connective tissue near the pharyngeal region located next to the ventral aorta.
- Irregular or oval follicular lumen
- Surrounded by flattened, cuboidal epithelial cells
- Measure follicle size, cell heights, roundness, form factor and aspect ratio.

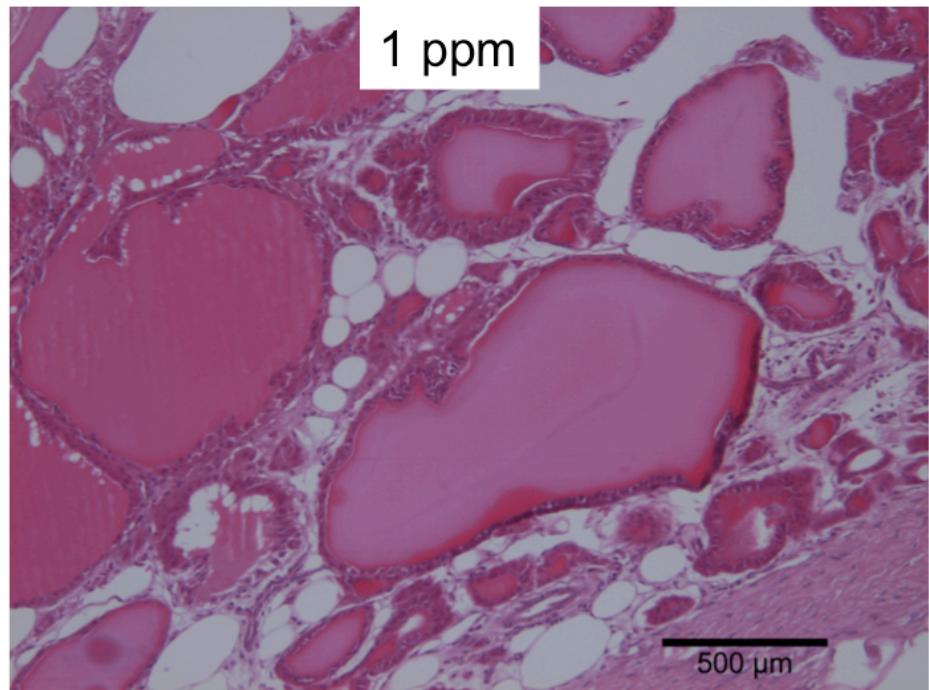
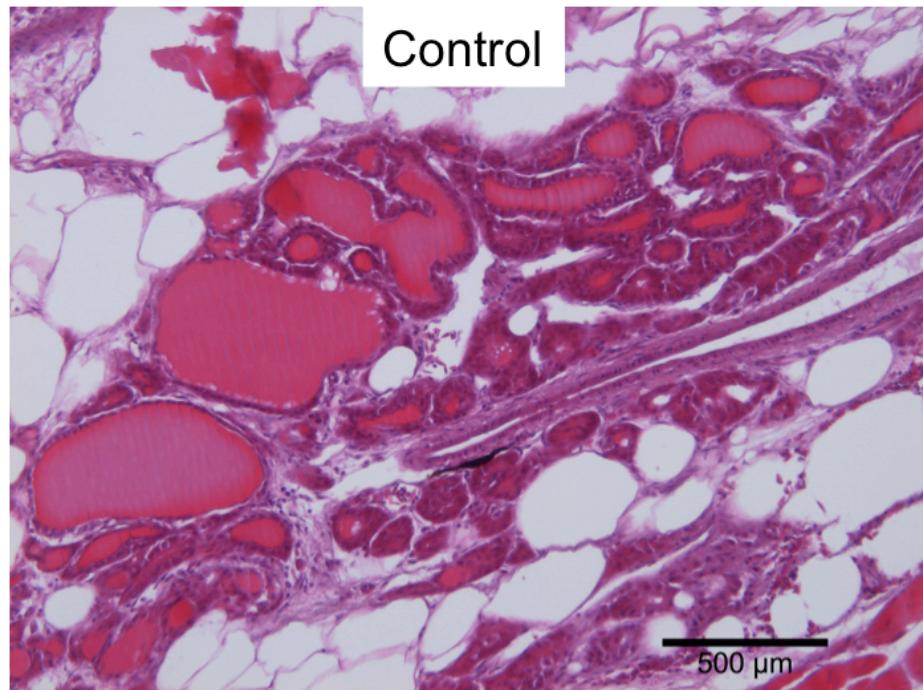


# Histomorphometry



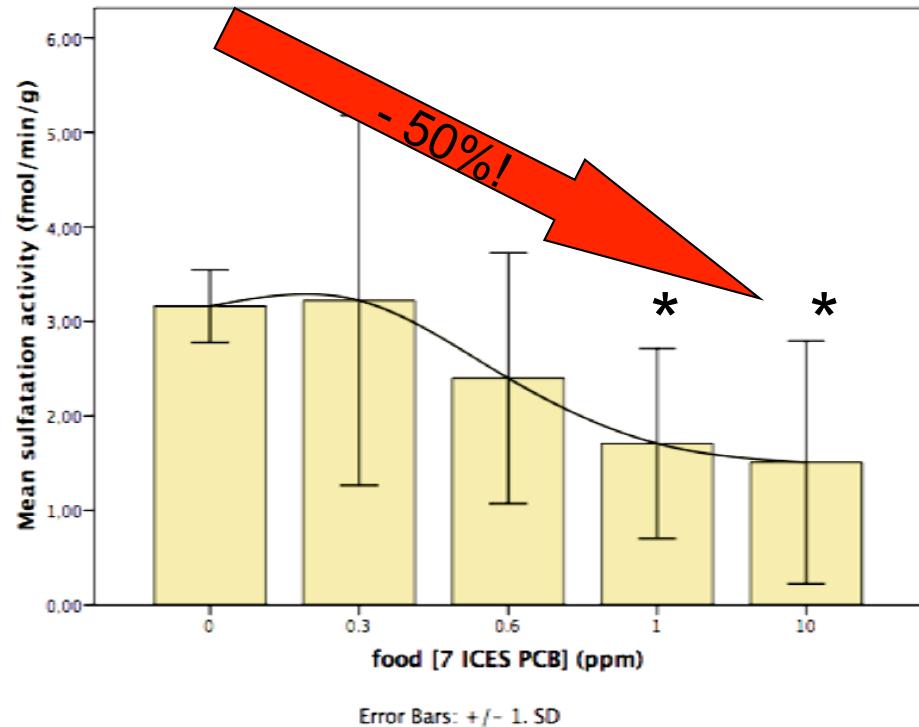
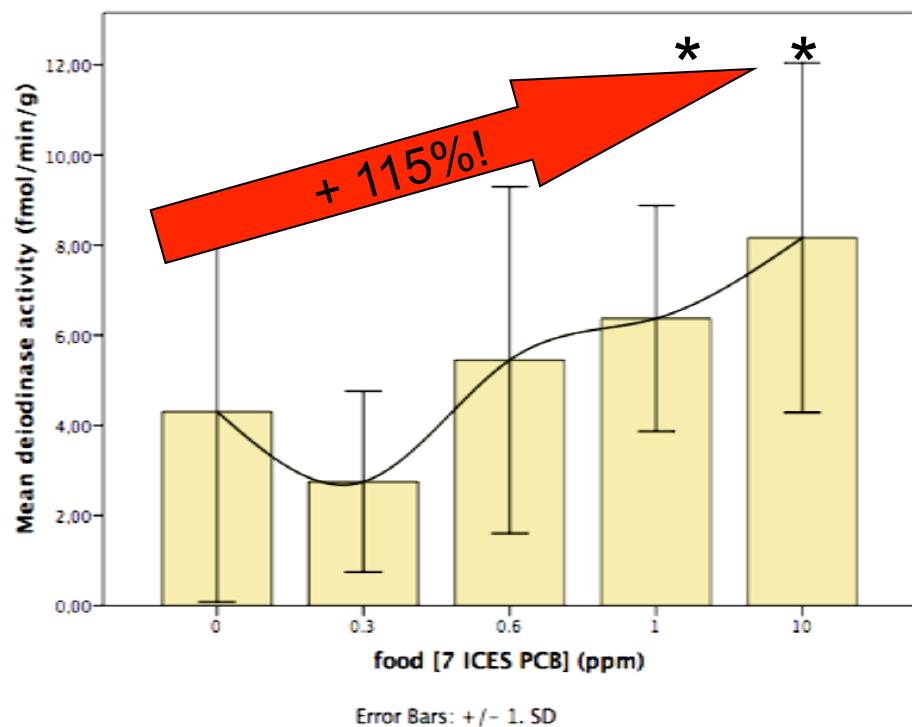
- ◆ No clear relationship to pollutant levels

# Thyroid Histology



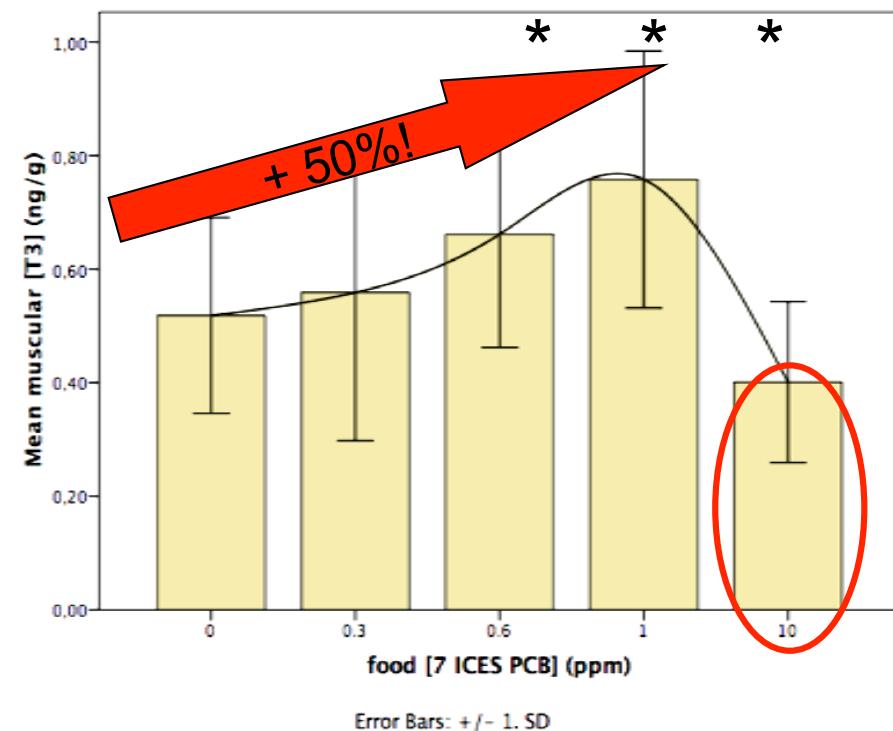
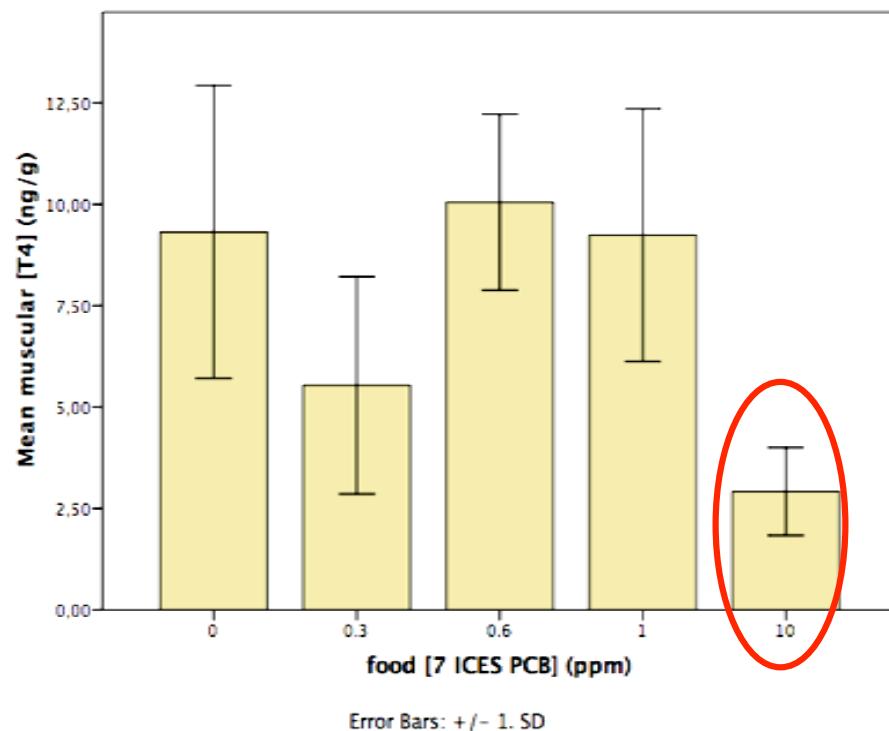
- ◆ Heterogeneity of follicle size

# Metabolic activity



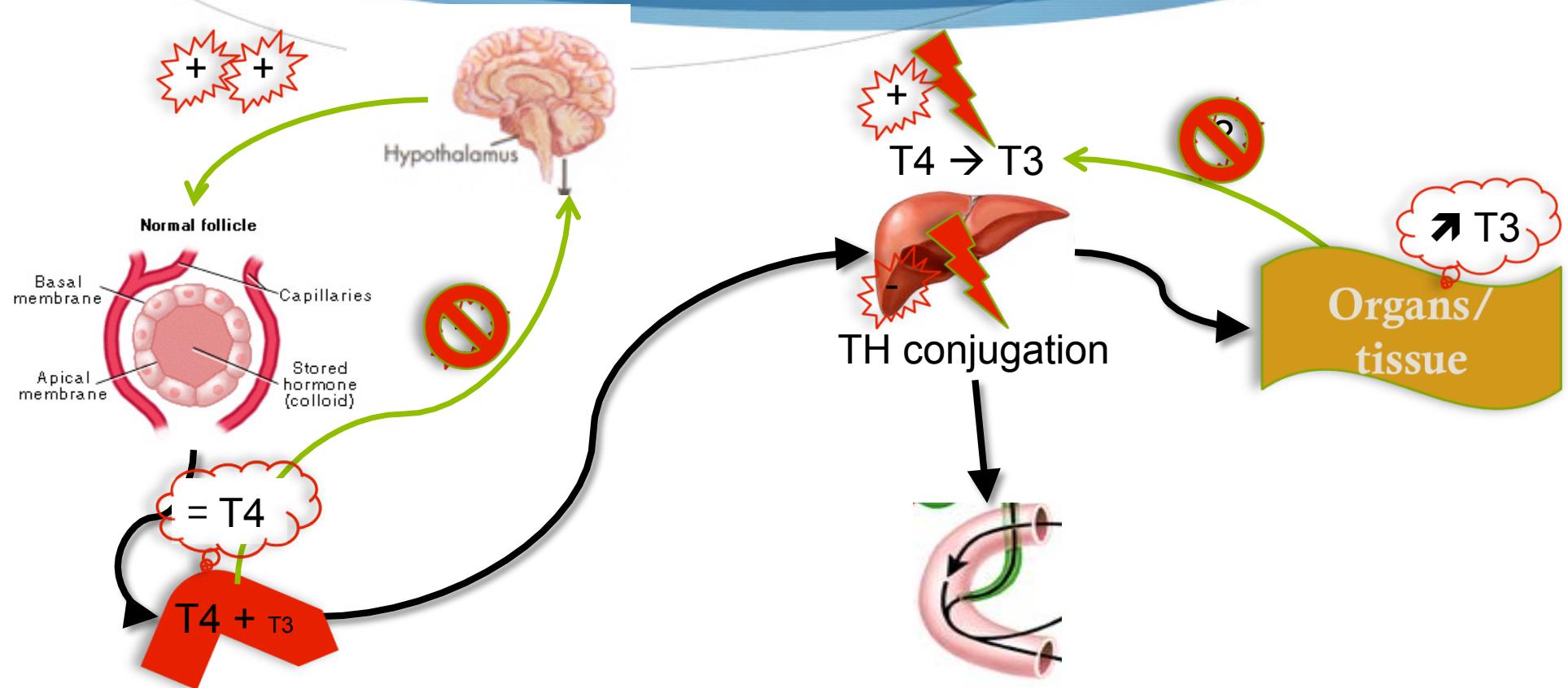
- Towards more conversion of T4 to T3 and less elimination of thyroid hormones

# Thyroid status



- Thyroid hormone levels preserved in environmental relevant exposure
- important depression @10ppm!

# Environmental relevant concentrations



$T4 \rightarrow$  Centrally controlled brain-pituitary-thyroid axis

$T3 \rightarrow$  Peripheral control in extra-thyroidal tissues

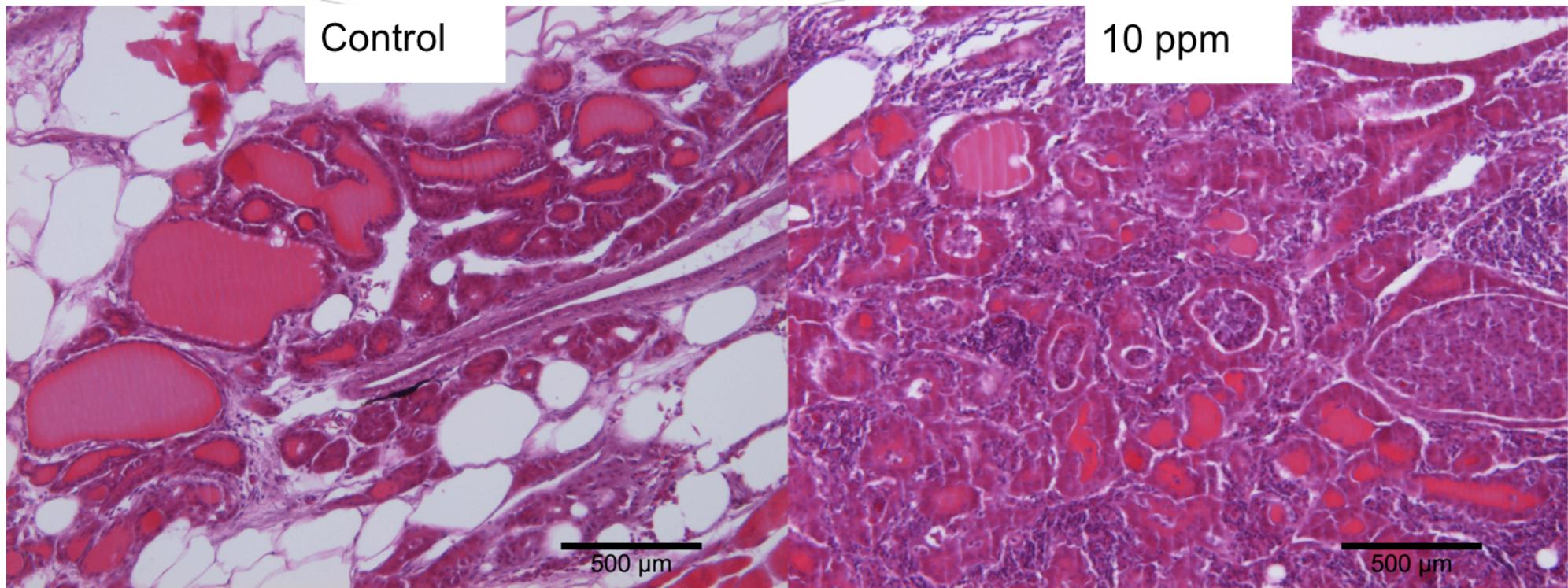
# Conclusions

- In sea bass exposed to environmental relevant concentrations of PCBs, we observe :
  - Preserved thyroid hormone status
  - Changes in activity of metabolic pathways
  - Changes in synthesis/secretion activity

**→ Compensation by extensive autoregulatory feedback**

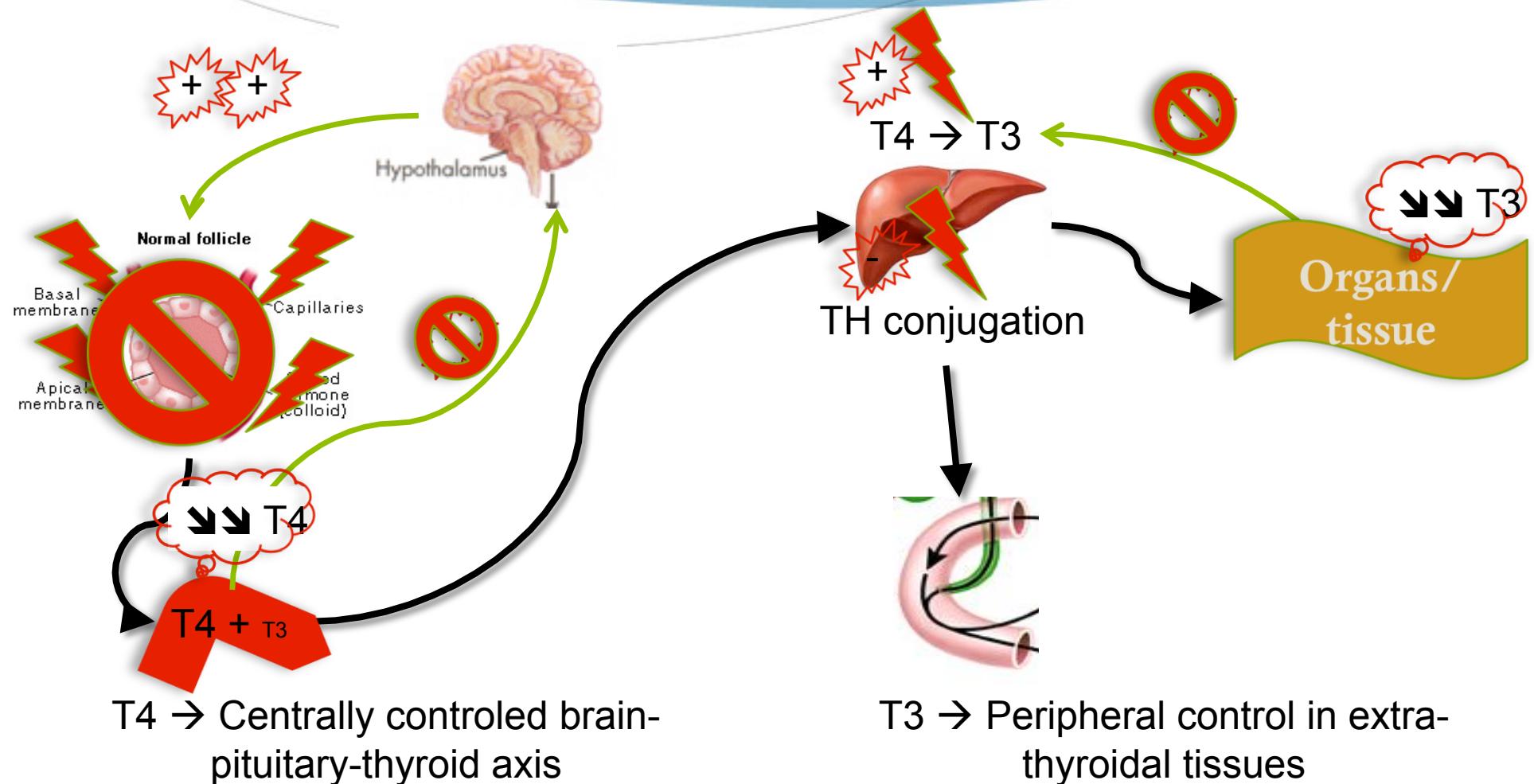
- We see @ higher contamination levels:
  - Depression of thyroid hormone status

# @ 10 ppm



- ◆ lower number of follicles and disorganized tissue
- ◆ lymphoid cell infiltration, enlargement of interstitial tissue, degenerated colloid
- ◆ might have caused hypothyroidism in 10ppm fish!!!

@ 10 ppm



# Conclusions

- In sea bass exposed to environmental relevant concentrations of PCBs, we observe :
  - Preserved thyroid hormone status
  - Changes in activity of metabolic pathways
  - Trend of a raise of synthesis/secretion activity

**→ Compensation by extensive autoregulatory feedback**

- We see @ higher contamination levels:
  - Depression of thyroid hormone status

**→ Altered thyroid hormone synthesis!**

Thank you for your attention!!!

- Please come and have a look on my poster:

# WE373

- A field study on sea bass in European coastal waters

# Approaches for assessing potential impact of thyroid hormone disrupting chemicals in wild sea bass (*Dicentrarchus labrax*)

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## INTRODUCTION

Organic compounds such as pesticides and polychlorobiphenyls (PCBs) are well described endocrine disruptors; of particular interest are effects on thyroid function. To assess the ability of occurring pollutants in European coastal areas to disrupt the thyroid system in European sea bass (*Dicentrarchus labrax*) (Fig. 1), a field study in the major European estuaries, namely, the Scheldt, the Seine, the Loire, the Charente and the Garonne has been conducted.

Fig. 1: European Sea Bass (*Dicentrarchus labrax*)

## MATERIALS AND METHODS

Several thyroid endpoints were simultaneously examined. Diameter of follicles and the epithelial cell heights give an indication on the production and secretion activity of the thyroid gland. The activity of enzymes involved in the metabolism (deiodination, glucuronidation and sulfatation) of thyroid hormones were determined.

## RESULTS AND DISCUSSION

- ✓ The contamination levels were as follows, the highest concentrations were measured in individuals collected from the coastal region near the Scheldt > Seine > Loire > Charente and the lowest levels were observed in sea bass from coastal regions near the Garonne (Fig. 2).
- ✓ The measured levels were generally higher than those reported in literature in sea bass from other regions (Fig. 2).

Fig. 2: Organochlorine pollutant contamination levels in muscles of European sea bass expressed as lipid weight. The lipid weight values are in light brown.  $\Delta$  =  $\Delta$  1997;  $\square$  =  $\square$  1998;  $\circ$  =  $\circ$  1999;  $\times$  =  $\times$  2000;  $\diamond$  =  $\diamond$  2001;  $\triangle$  =  $\triangle$  2002;  $\circ$  =  $\circ$  2003.

- ✓ Contamination patterns were different depending on the sampling area and thus the river input of pollutants (Fig. 3).

Fig. 3: Plot of the results of discriminant analysis for interstitial comparison of contamination patterns on the basis of lipid weight normalized organochlorine compound concentrations

Finally thyroxine (T4) and triiodothyronine (T3) concentrations were analyzed in muscle by radioimmunoassay. The combined use of all these endpoints gives us an overview of the complex thyroid hormone system.

Fig. 4: Mean deiodination and sulfation activity in sea bass liver

✓ Owing to the extensive autoregulatory feedback at both central and peripheral levels, the thyroid hormone concentrations were preserved thanks the PCB induced changes in thyroid hormone dynamics (Fig. 5).

Fig. 5: Mean muscular thyroid hormone concentrations (T4 and T3)

- ✓ Please come and see the presentation of the experimental part of this study **today at 15h20** In Sala Albaicin 2!