

**Rehabilitation failures of oil-covered birds:  
Effects of re-feeding on the digestive tract,  
the body energy stores and the immune system**

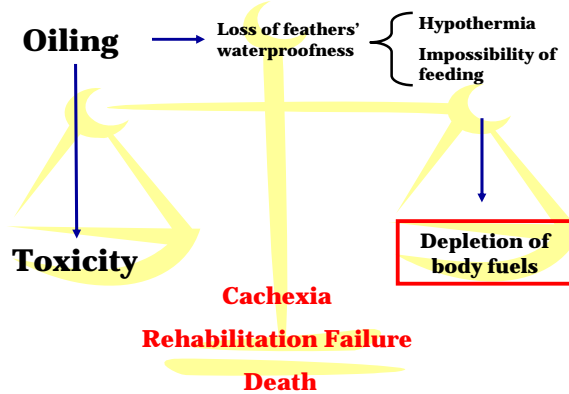


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**Effects of oil on birds**

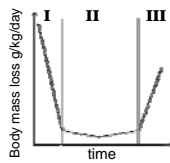


**Adaptations to fasting**

**Optimal use of body reserves**

*Le Maho et al. 1981*

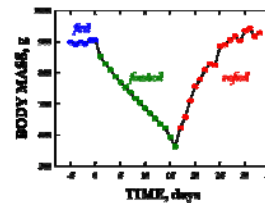
- phase I: glycogen
- phase II: lipids, reduced metabolism, atrophy of gut
- phase III: proteins



**Adaptations to fasting**

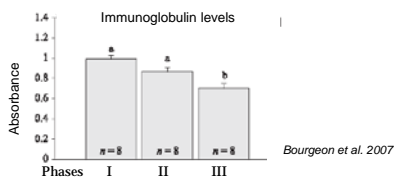
**In natural or laboratory conditions:  
efficient re-feeding**

*Robin et al. 1991, 2001*



**Immunity and energetic challenges**

**-in force-fasted birds : example of King penguin**



*Bourgeon et al. 2007*

**-in oil-intoxicated**

Lack of data *Briggs et al. 1996*

**Clinical features**



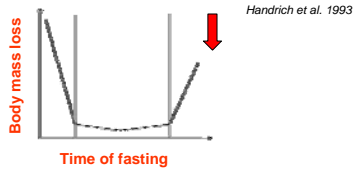
**Care centres or dead beached birds :**

- Cachexia, «haemorrhagic diathesis»  
*Debacker et al. 1997, Balseiro et al. 2005*
- Numerous re-feeding failures  
*Khan & Ryan 1991*
- Nosocomial infections  
*Le Drean-Quénéec'Hdu et al. 2002*

**Only 3-10% of birds are released in the wild  
after an oil spill**

Care centres

## Questions



1. Irreversible atrophy of intestine?
2. Assimilation?
3. Deficiency of the immune system?

## Context: Napoli oil Spill

20<sup>th</sup> January 2007 MSC-Napoli  
 South of England, 6-200 t of hydrocarbons  
 Ligue de Protection des Oiseaux (LPO care centre), Ile Grande, France



Estimation: 5 to 10 000 oiled birds  
 2000 beached birds in England,  
 370 in France

## Methods

### Common Guillemot

under 600g (~40% Body Mass)

-13 euthanized at the arrival while fasting

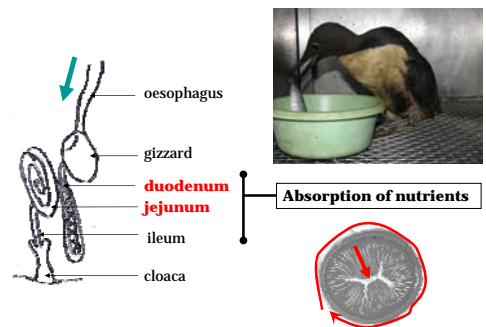
-7 euthanized after 24-72h re-feeding *ad libitum*



Rectal temperature and blood sampling before euthanasia and dissection

- Duodenum and jejunum: morphometry
- Skin and pectoral muscle: stores (lipids and proteins)
- Blood sample: humoral immunity parameters (innate and acquired)  
 / 6 non-intoxicated control

## Digestive tract



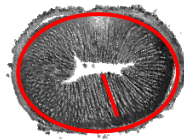
## Morphometrical measurements

**Jejunum:** Fasted

Re-Fed

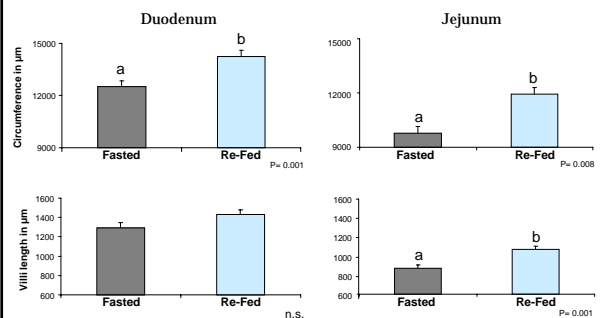


Circumference = 8 300  $\mu\text{m}$   
 Villi lengths = 890  $\mu\text{m}$



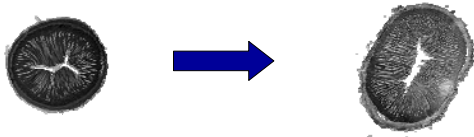
Circumference = 10 100  $\mu\text{m}$   
 Villi lengths = 980  $\mu\text{m}$

## 1. Irreversible atrophy of intestine?



### 1. Irreversible atrophy of intestine?

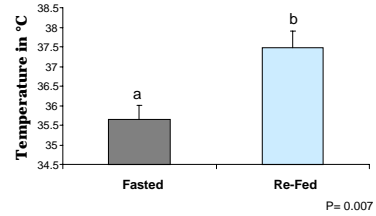
No!



Morphometrical restoration of the intestine

### 2. Assimilation?

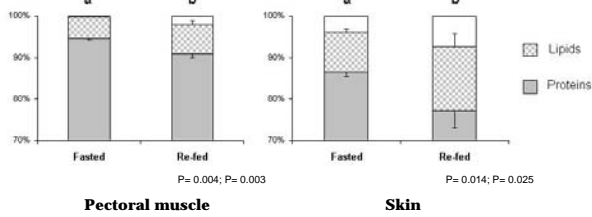
Rectal temperature



Increase of temperature is a clue of digestive activity

### 2. Assimilation?

Tissue composition (% dry mass)



Evidence of assimilation and storage in organs

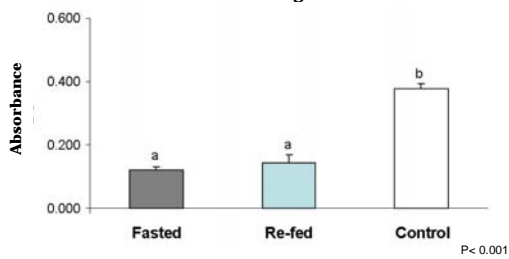
### 2. Assimilation?

Yes!

- Digestive activity
- Assimilation and storage in organs

### 3. Deficiency of the immune system?

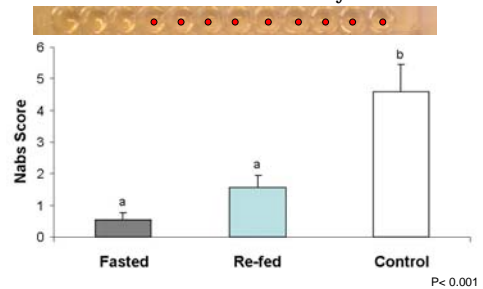
Plasma immunoglobulin level



Deficiency of acquired immunity in oil-intoxicated birds

### 3. Deficiency of the immune system?

Innate humoral immunity



Deficiency in innate immunity in oil-intoxicated birds

### 3. Deficiency of the immune system?

**Yes!**

Immuno-depression by deficiency of both  
the acquired & innate humoral immunity

### Conclusion

#### 1. Irreversible atrophy of intestine?

Reversibility of the fasting induced digestive atrophy

#### 2. Assimilation?

Increase of rectal temperature and storage in the organs

#### 3. Deficiency of the immune system?

Deficiency of acquired and innate humoral immunity

### Discussion

Energetic cost of immunity

Energetic cost of toxicity

Loss of appetite, anorexia

~~Default of assimilation~~



**Re-feeding Failures**

### Perspectives

Impact of stress?

-Corticosterone, CBG

-Oxidative stress

Improvement of:

-Immunity recovery

-Appetite & wellness of birds

## Thank you

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