Chirotech, Six years of research (2006 – 2012)

Conference Paper · February 2013

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Chirotech

Six years of research (2006 – 2012)

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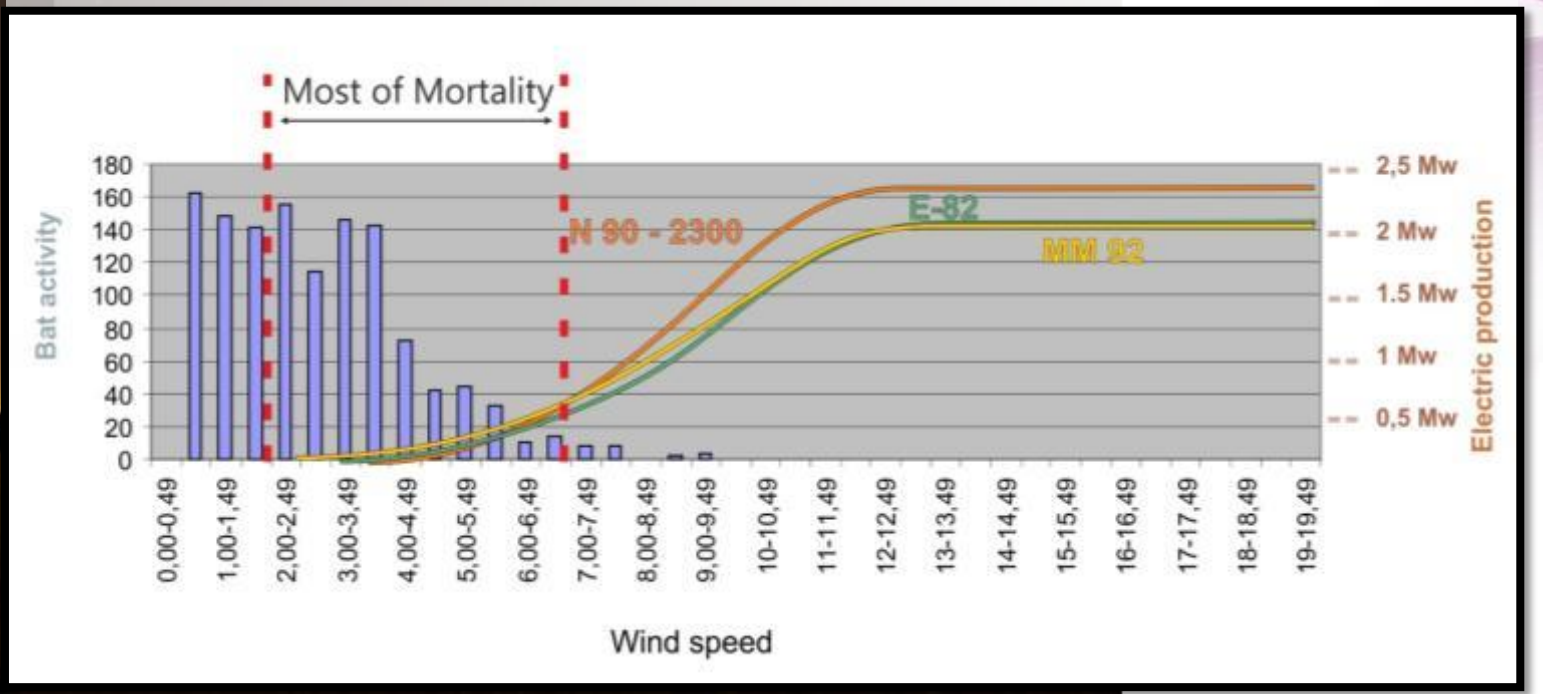
1 - Context and goal of Chirotech

- Research program reconciling conservation of bats and development of wind facilities.
- **Hypothesis** : Peaks of bat activity don't match peaks of production of wind turbines.



1 - Context and goal of Chirotech

- **Goal** : Regulation of wind turbines in function of peak's activity of bats without a significant loss of production

To do this :

- **Collection data** of bat behavior at turbine's height to **model bats activity** according to environmental parameters

- **Mitigation of wind turbines** according to model bats activity as a function of environmental parameters

2- Characterizing activity : Material et method

- **To model the bats behavior based on :**

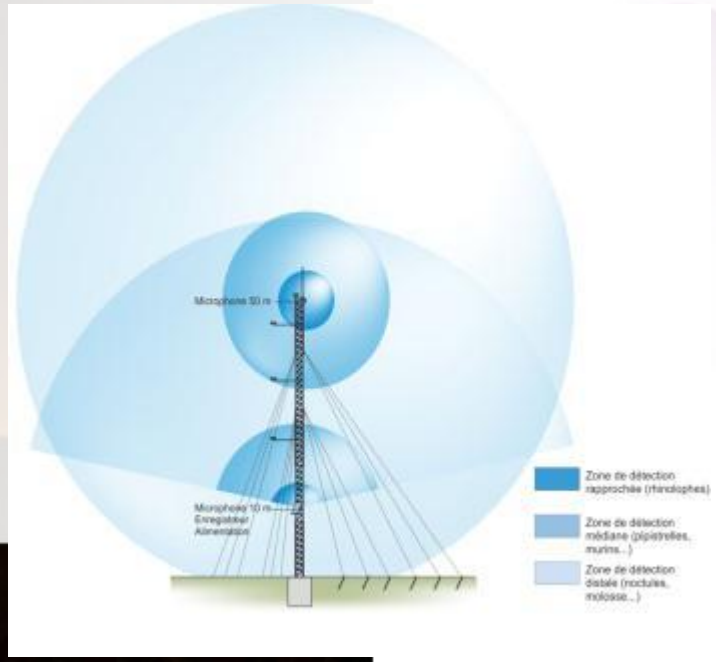
  - Time **- Wind speed**

  - Season **- Temperature** **-Altitude**

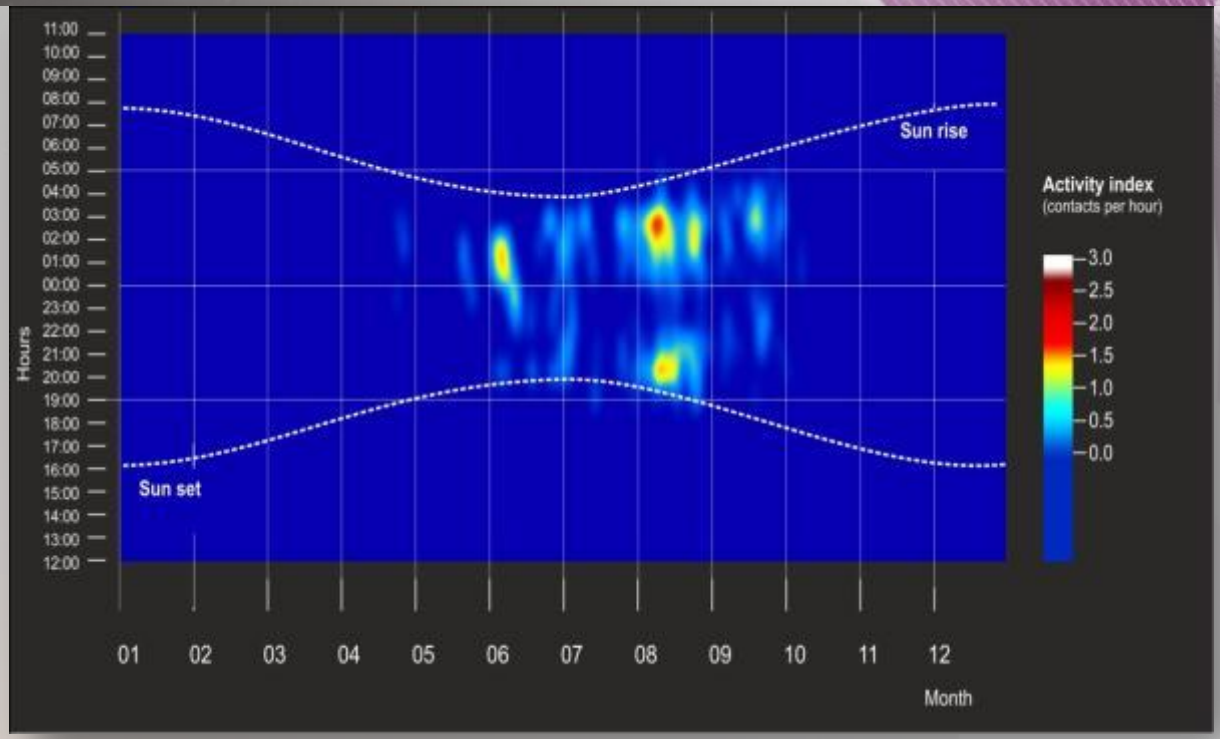
From 2006 to 2011 : **10 initial sites** with **AnaBat**

Since 2011 : **29 sites** equipped with **SM2Bat**

Microphones fixed
for 1 year
at 5m and 50m high



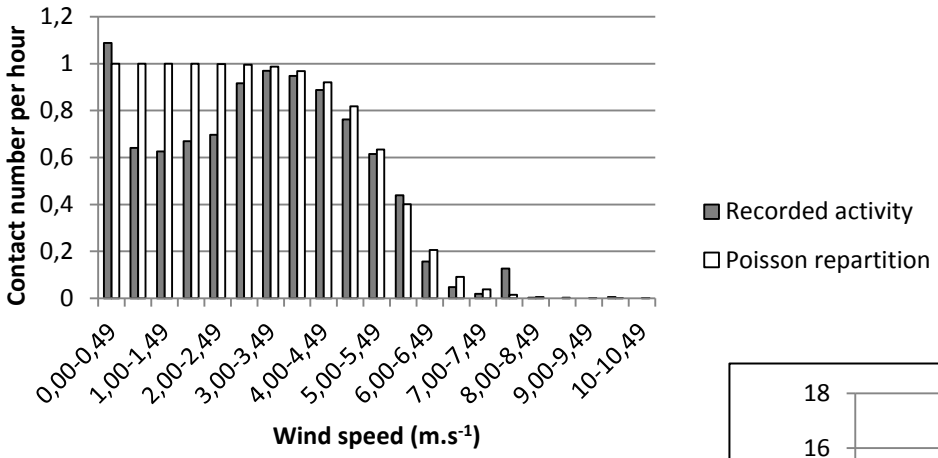
2- Characterizing activity : Results



Peak activity of bats :

- **April to September** (very site-dependent)
- **2-4 hours after sunset**
- Secondary peak **before sunrise** on some sites

2- Characterizing activity : Results

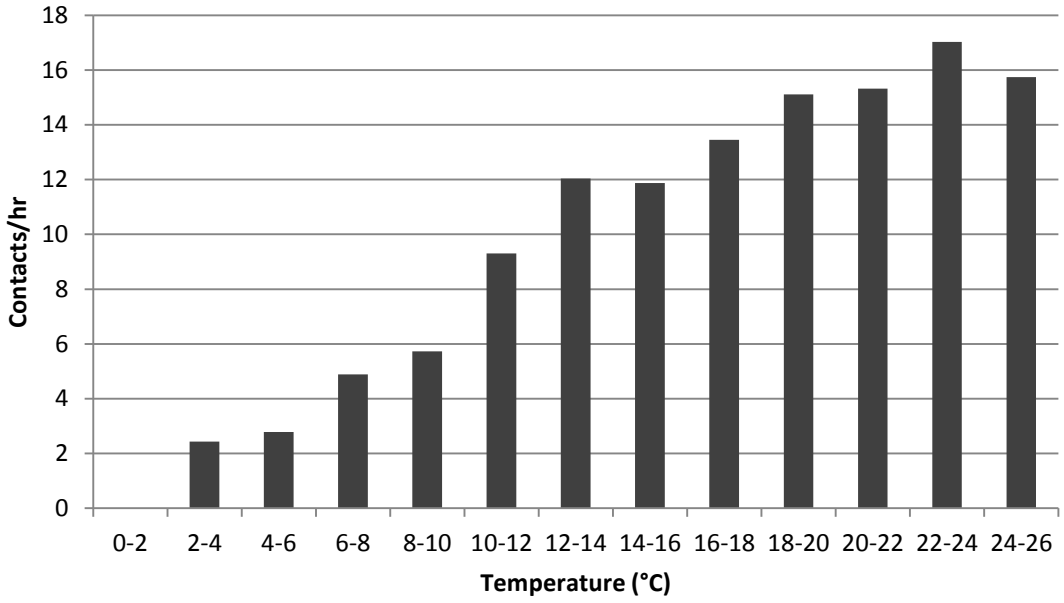


Pattern variations in activity according to wind speed

Peak activity of bats :

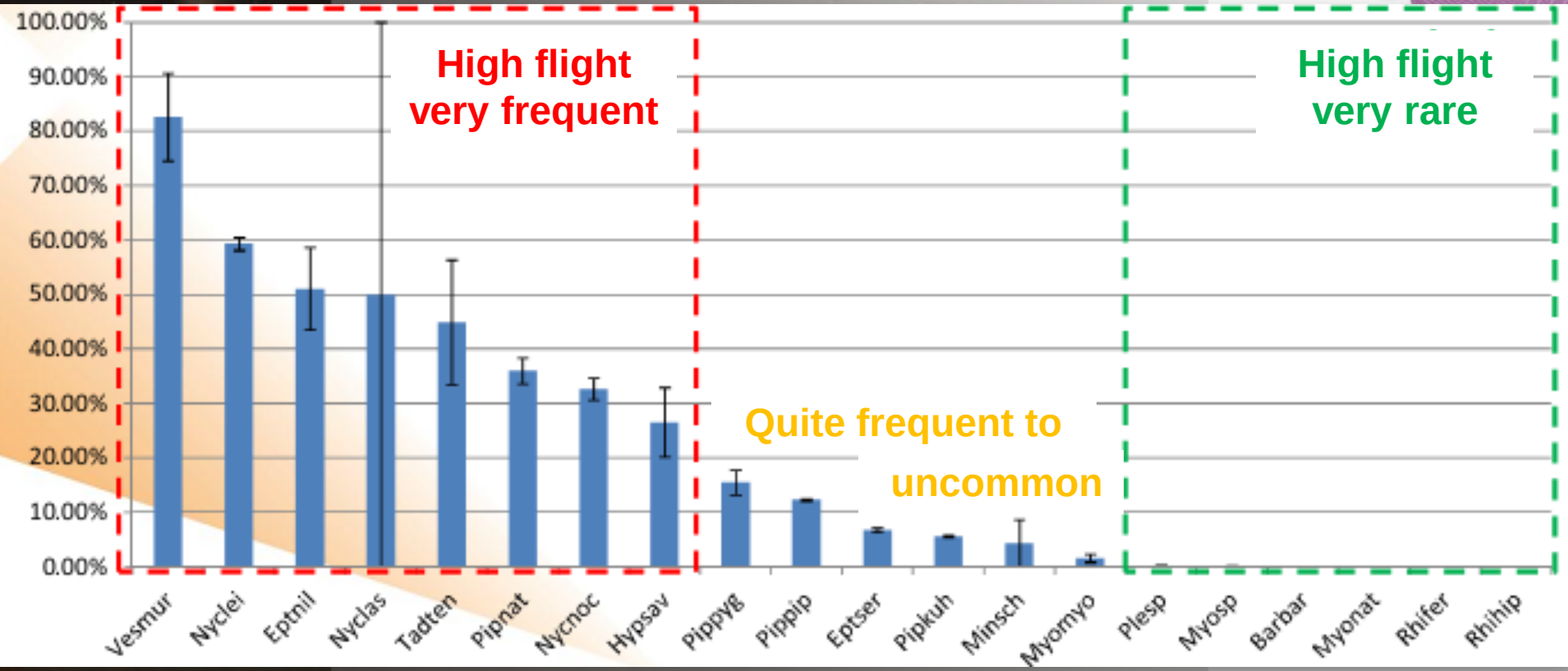
- Wind speed below **3-7 m.s^{-1}**
- Temperature **above 8-15°C**

Pattern variations in activity according to temperature.



2- Characterizing activity : Results

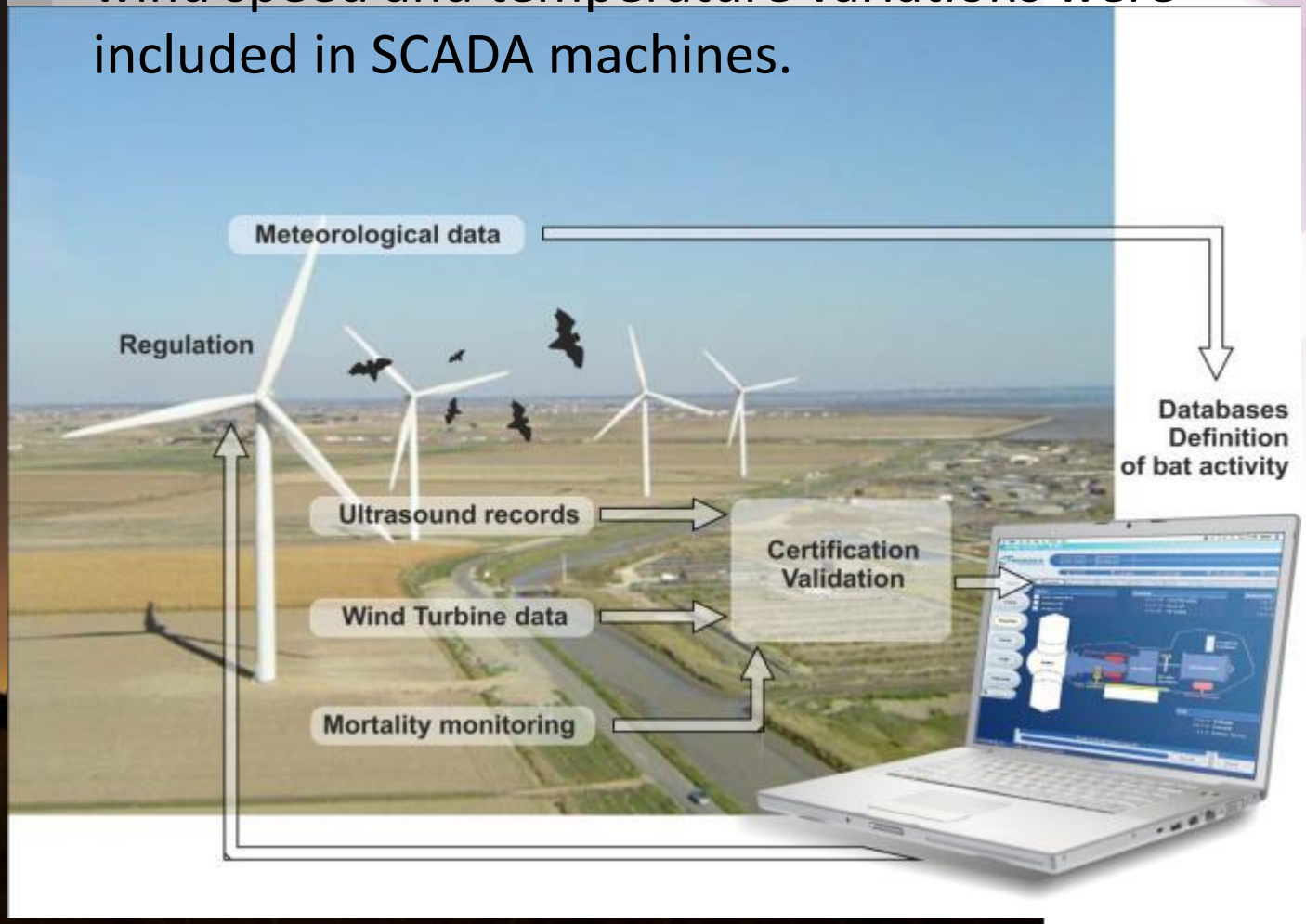
- **Flying time at > 25 m high, by species**



Y. Bas, 2012

3- Regulation of wind turbines

- Combination of temporal variation and response to wind speed and temperature variations were included in SCADA machines.



4- Regulation tests of wind turbines

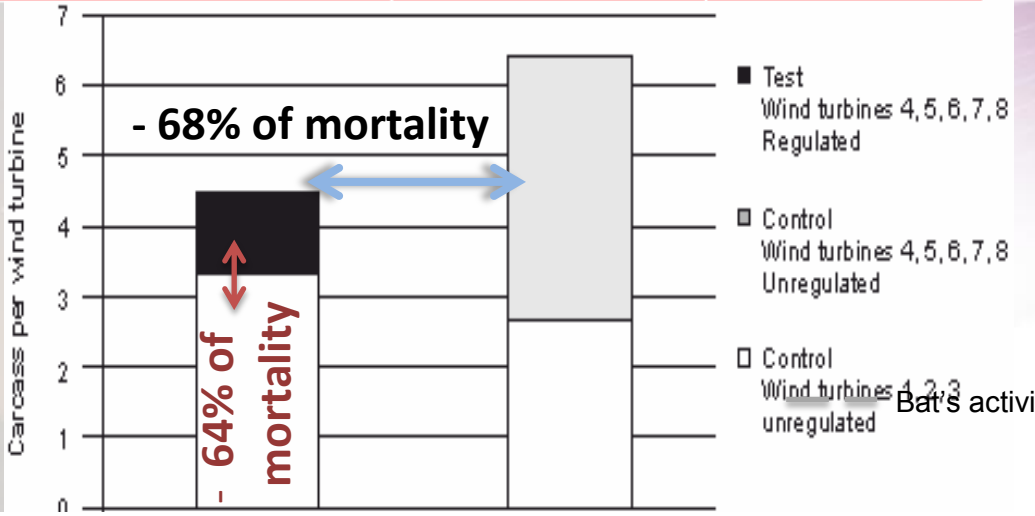
Wind farm in Vendée (Bouin)

2 years of test **(2009 - 2010)**

Each year, monitoring during 12 weeks once a week

Date	Wind Farm	Number of carcass under the control turbines	Number of carcass under the regulated turbines	Decrease of mortality	Loss of production
2009 - 2010	Bouin			64%	<0,1%

- 5 regulated wind turbines
- 3 control wind turbines



Bat's activit

There was strong evidence of regulation effectiveness: the interaction of treatment and period differed significantly ($F_{1,157}$ = 6.082, P = 0.014, Fig. 4), while the treatment and period taken separately did not ($F_{1,158}$ = 0.001, P = 0.995; $F_{1,158}$ = 3.027, P = 0.082).

4- Regulation tests of wind turbines

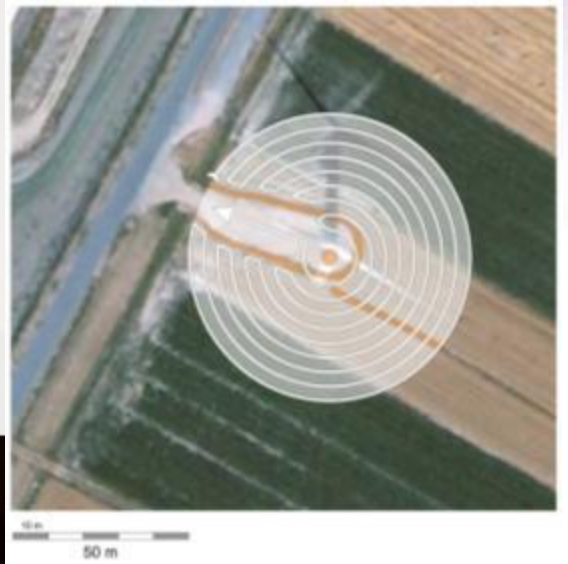
Wind farm in Crau (Mas-de-Leuze)

- 2 years of test
  (2011-2012)

- Each year, monitoring
  during **14 weeks**
  every 3 days

- 4 regulated wind turbines
  4 control wind turbines

- 7 weeks of regulation
  7 periods



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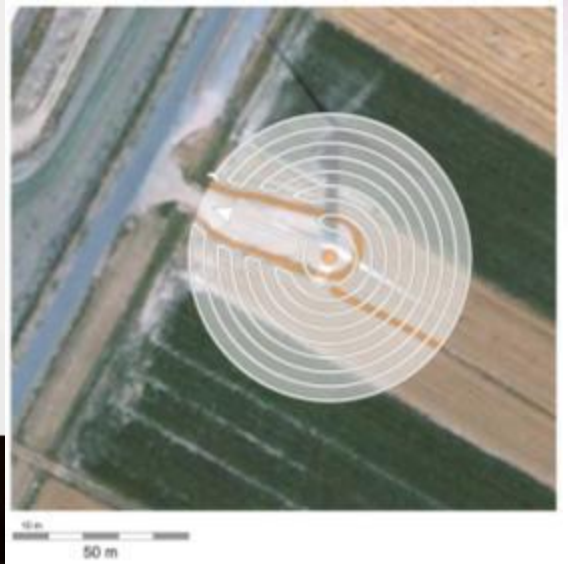
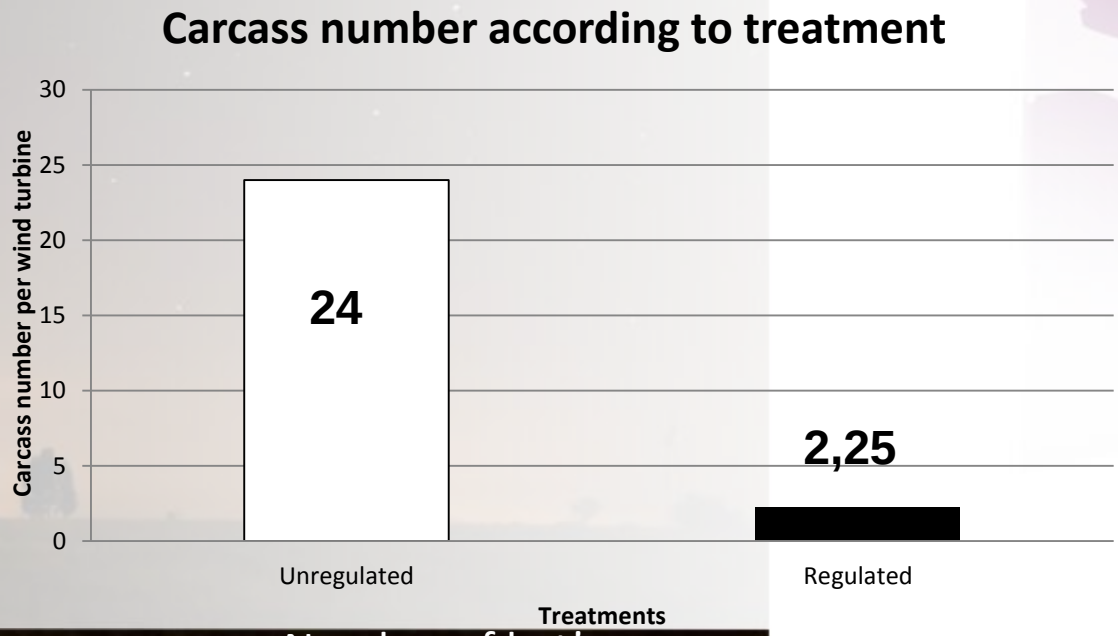


4- Regulation tests of wind turbines

Date	Wind Farm	Number of carcasses under the control turbines	Number of carcasses under the regulated turbines	Decrease of mortality	Loss of production
2009 - 2010	Bouin			64%	<0,1%
2011 - 2012	**Mas de Leuze**	**96**	**9**	**90,45%**	**<0,27%**

- Mortality 90,45% lower under regulation

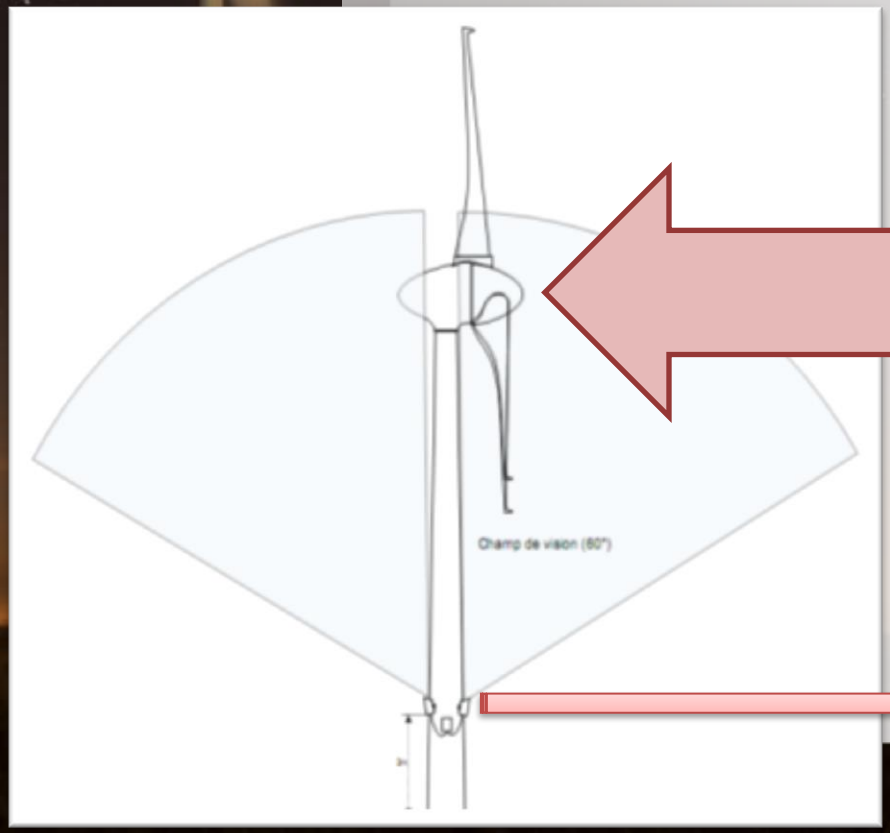
-Calculated loss of production <0,27 % (Enercon)



Number of bat's carcass (model GAM, P>0,01)

4- Improvement and deployment of industrialization

- **Automated tracking of bat's activity by thermal cameras (Decan®)**

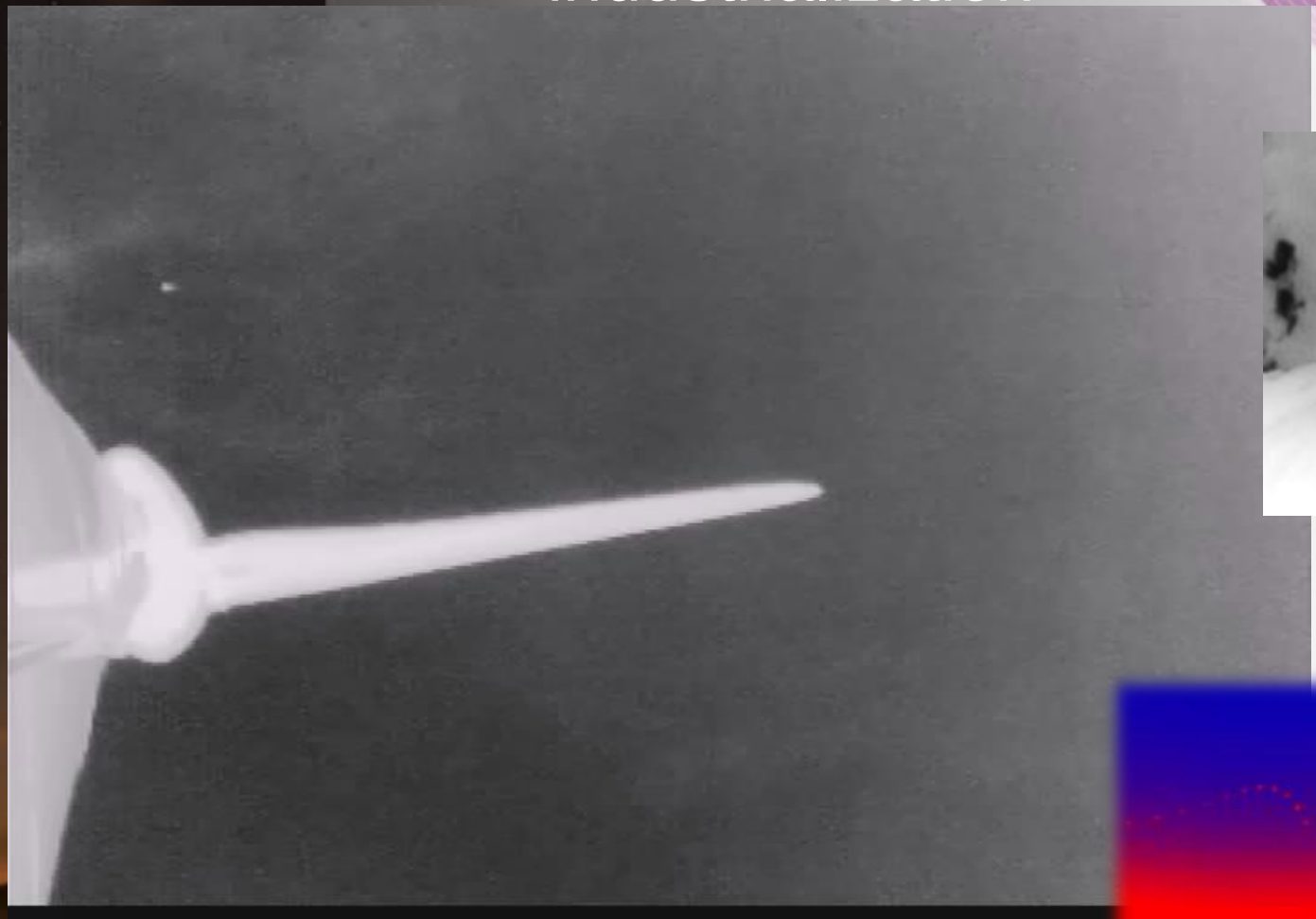


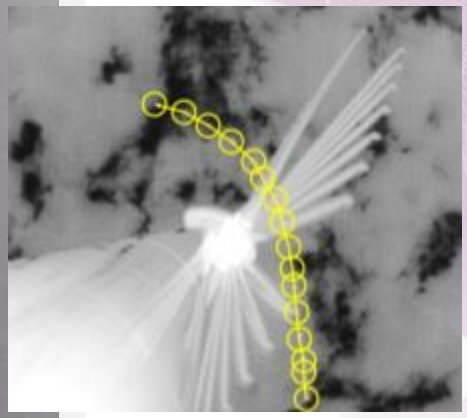
Chirotech®
Predictive algorithm based on **meteorological parameters**

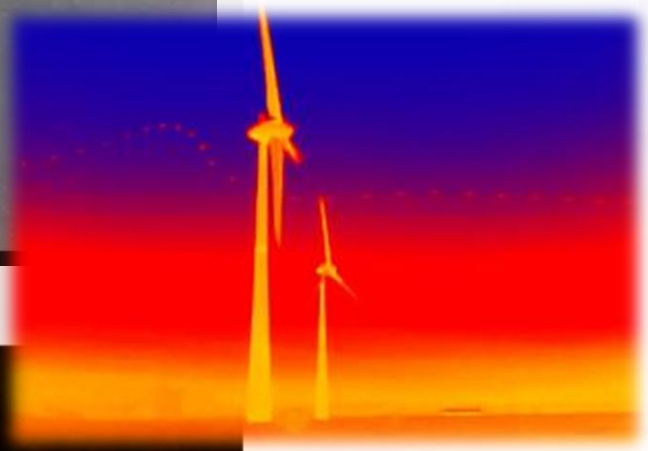
Order
STOP/START

Decan®
Analysis in **real time** with **thermal cameras**

4- Improvement and deployment of industrialization







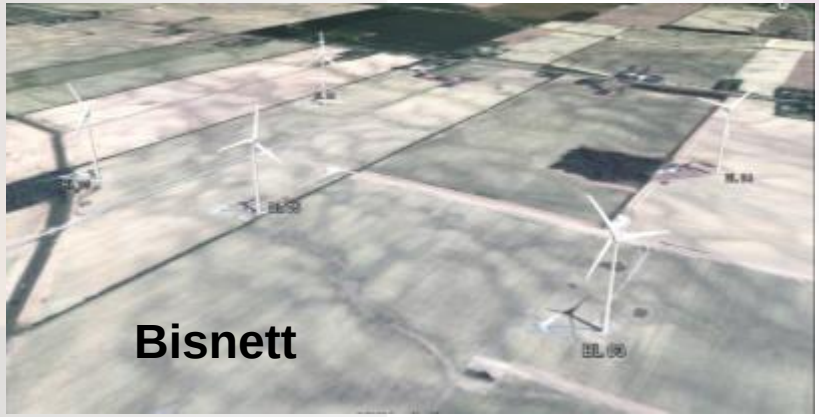
4- Improvement and deployment of industrialization

Two wind farms in Ontario (FrontLine and Bisnett)

- Bat mortality monitoring during **12 weeks twice a week**

- 3 control wind turbines
- 2 regulated wind turbines

- 12 regulated weeks

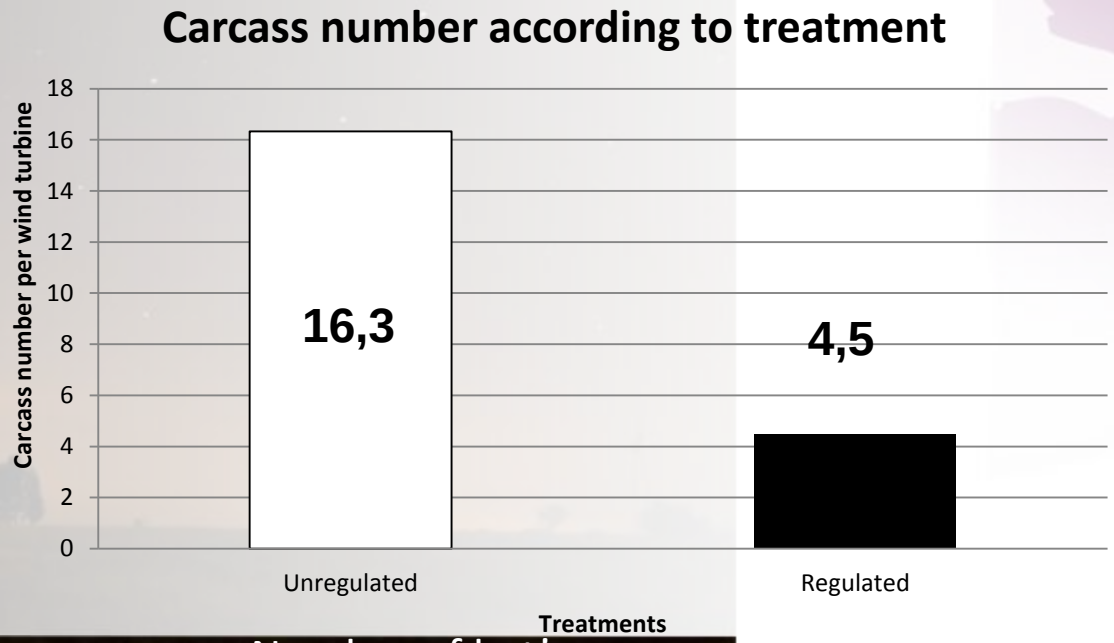


4- Improvement and deployment of industrialization : Results

Date	Wind Farm	Number of carcass under the control turbines	Number of carcass under the regulated turbines	Decrease of mortality	Loss of production
2009 - 2010	Bouin			64%	<0,1%
2011 - 2012	Mas de Leuze	96	9	90,45%	<0,27%
2012	**Front Line**	**49**	**9**	**78%**	**<1%**

- Mortality 78% lower under regulation

-Calculated loss of production <1 %



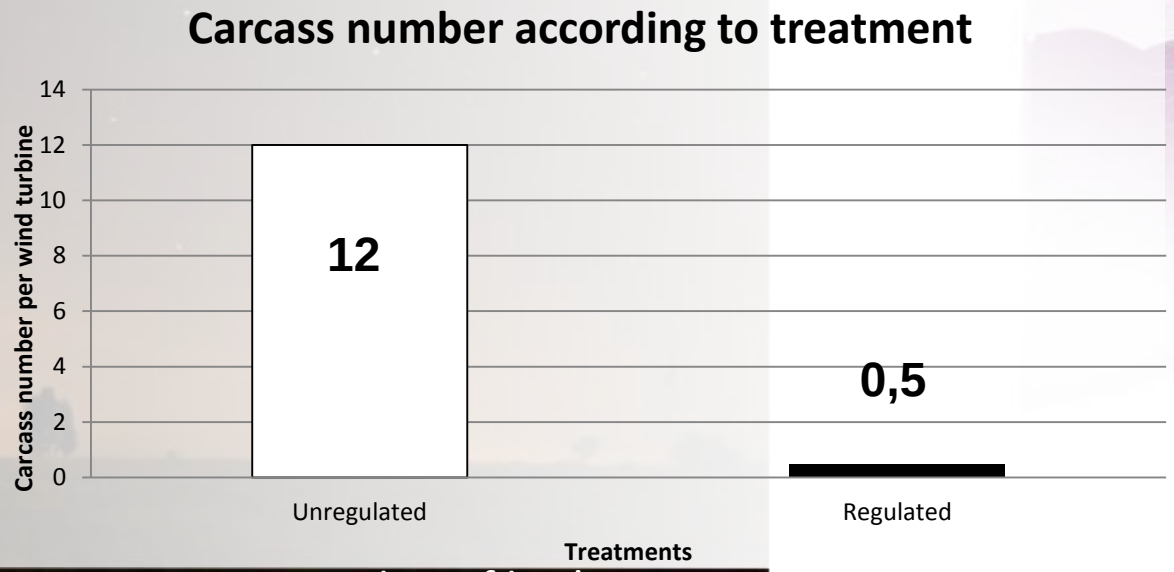
Number of bat's carcass (model GAM, P>0,01)

4- Improvement and deployment of industrialization : Results

Date	Wind Farm	Number of carcass under the control turbines	Number of carcass under the regulated turbines	Decrease of mortality	Loss of production
2009 - 2010	Bouin			64%	<0,1%
2011 - 2012	Mas de Leuze	96	9	90,45%	<0,27%
2012	Front Line	49	9	78%	<1%
2012	**Bisnett**	**36**	**1**	**96,70%**	**<0,68%**

- Mortality 96,7% lower under regulation

-Calculated loss of production <0,68 %



Number of bat's carcass (model GAM, P>0,01)

Conclusion

- Efficient solution: 60-97% decrease in mortality for loss of production less than 1%
- Configurable and adaptable, depending
  - turbine specificity,
  - local behavior of bats,
  - local environmental conditions
- Adapted to migration patterns and annual phenology (for activity monitoring with thermal cameras or SM2Bat)
- Industrial certification pending