

Combining performance-based and action-based payments to provide environmental goods under uncertainty

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Outline

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- 2 Research questions
- 3 Advantages and disadvantages of payment schemes
- 4 The model
- 5 Results – obstacles – outlook

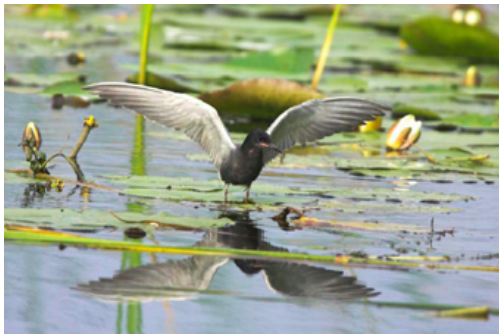
Case study - Special Protection Area (SPA) Eiderstedt Black Tern (*Chlidonias niger*)



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Case study - Special Protection Area (SPA) Eiderstedt

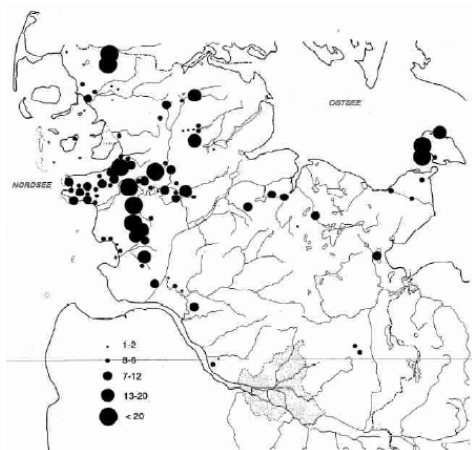
Case study - Special Protection Area (SPA) Eiderstedt

Protection and enhancement of the Black Tern (*Chlidonias niger*)

- Bird conservation area in terms of the EU bird-directive for the protection of the Black Tern
- Farmers protested when the Special Protection Area (SPA) was implemented
- Voluntary contracts for the protection of the species have been implemented
- But: Since the indication of the area as SPA the bird population is declining
- ⇒ Implemented measures are not sufficient for the protection goal

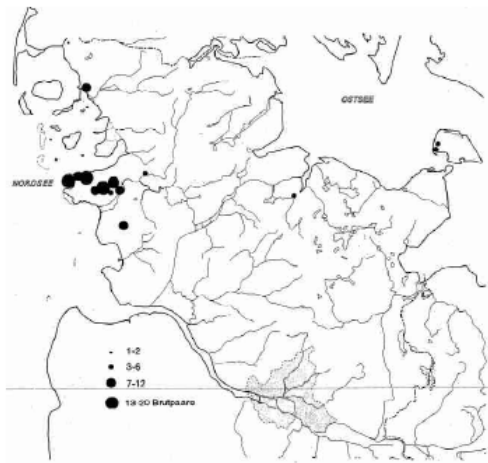
Case study - Special Protection Area (SPA) Eiderstedt

Breeding occurrence 1966

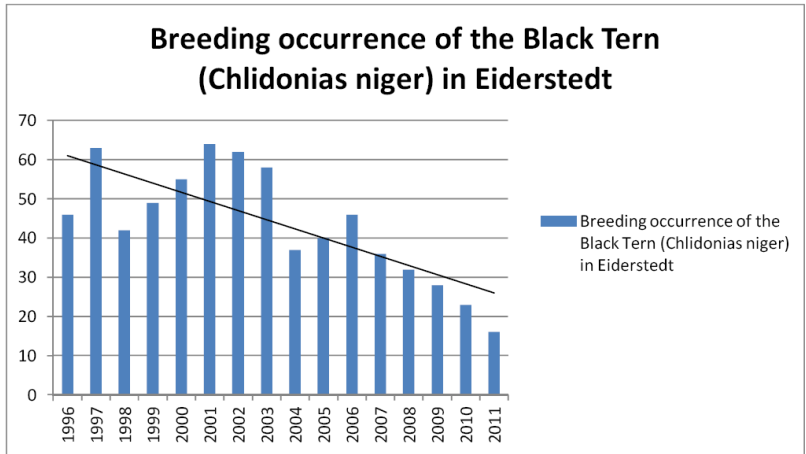


Case study - Special Protection Area (SPA) Eiderstedt

Breeding occurrence 2001



Case study - Special Protection Area (SPA) Eiderstedt



Review: payment schemes

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Performance-based payments

- „payment bound to a specified performance of the environment or ecosystem service“

Action-based payments

- „payment not directly bound to the performance but on predefined actions“

Review: payment schemes

Performance-based payments

- „payment bound to a specified performance of the environment or ecosystem service“
- allow to find best way of combining inputs to generate a desired level of environmental services (Hampicke 2004, Matzdorf 2006)

Action-based payments

- „payment not directly bound to the performance but on predefined actions“
- the action paid for may not be the best way to generate the environmental service

Review: payment schemes

Performance-based payments

- „payment bound to a specified performance of the environment or ecosystem service“
- allow to find best way of combining inputs to generate a desired level of environmental services (Hampicke 2004, Matzdorf 2006)
- risk goes at the expense of the agent

Action-based payments

- „payment not directly bound to the performance but on predefined actions“
- the action paid for may not be the best way to generate the environmental service
- little risk for agent even if performance is uncertain

Research questions

Implementing performance-based payments?

- Performance (enhancement of breeding population) is uncertain
- Action-based payments are already implemented but obviously not sufficient for the protection goal
- Heterogeneous farm structures and initial states

- ⇒ Should payments be based on performance or actions?
- ⇒ Is a combination of performance-based and action-based payments possible?

Combining performance-based payments and action-based payments

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Assumptions of the analytical model

- Environmental uncertainty - Stochastic disturbance and demographic noise
- Information asymmetry - Productivity of the actions are unknown by the principal
- Payment on a basis of a relative performance to prevent windfall gains

The Model

Production function:

$$\Delta y = \phi x + \varepsilon_d y_t + \varepsilon_e,$$

- Δy = growth of y = breeding population
- x = farmer's action
- ϕ = marginal productivity of x
 - perfectly known to the farmer
 - regulator knows only a probability distribution over ϕ with mean $\bar{\phi}$ and variance σ_ϕ^2
- stochastic disturbance ε consists of
 - demographic noise $\varepsilon_d y_t$, normally distributed with zero mean and standard deviation σ_d
 - environmental noise ε_e , normally distributed with zero mean and standard deviation σ_e

The Model

Agents payment ω :

$$\omega = b + ax + p\Delta y$$

- b = base payment
- a = action-based payment
- p = performance-based payment depending on Δy

The Model

Agents payoff:

$$Y = \omega - \frac{c}{2} x^2$$

Risk averse agent with constant absolute risk aversion (CARA):

$$U = E[-\exp(-\eta Y)]$$

Expected utility of the agent for subscribing the contract has to be no less than his reservation utility $U(0) = -\exp(0) = -1$:

Risk neutral principal:

$$E[\Delta y - \omega]$$

Combining performance-based and action-based payments

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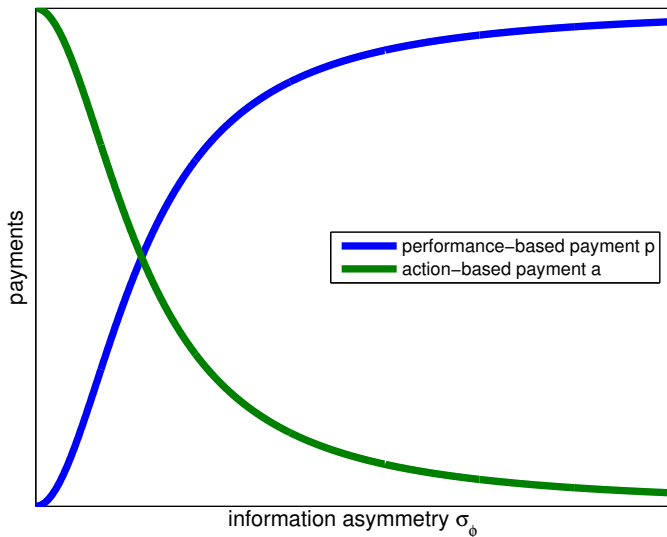
Temporal structure of the model

- 1 The principal announces the payment scheme (a, p)
 - a action-based payment
 - p performance-based payment
- 2 The farmer decides on whether or not he would like to participate in the program
- 3 The farmer chooses his action x
- 4 Nature chooses stochastic disturbance $\varepsilon = (\varepsilon_d, \varepsilon_e)$
- 5 Payments are made

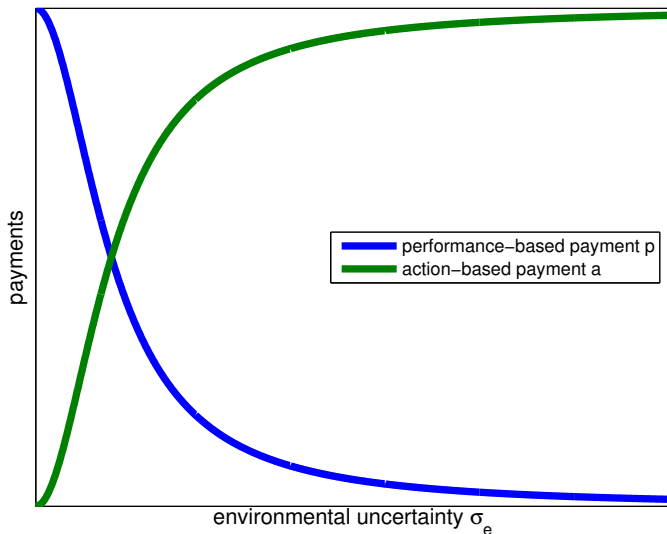
Optimal payments for the principal:

$$p = \frac{\sigma_{\phi}^2}{\sigma_{\phi}^2 + c \eta (\sigma_d^2 y_t^2 + \sigma_e^2)}$$
$$a = \bar{\phi} \frac{c \eta (\sigma_d^2 y_t^2 + \sigma_e^2)}{\sigma_{\phi}^2 + c \eta (\sigma_d^2 y_t^2 + \sigma_e^2)}$$

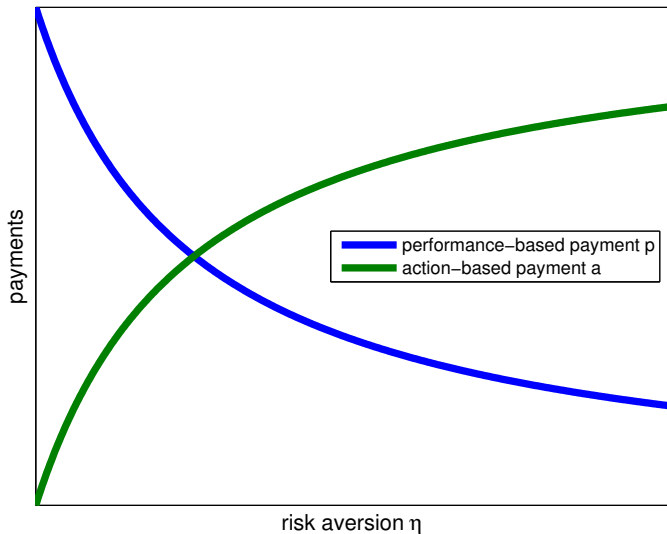
Combining performance-based and action-based payments



Combining performance-based and action-based payments



Combining performance-based and action-based payments



Interpretation and results

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'Should payments be based on performance or actions?'

- a pure performance-based payment is optimal only if $\sigma_e = \sigma_d = 0$ or $\eta = 0$
- a pure action-based payment is optimal only if $\sigma_\phi = 0$

'Should a payment be based on absolute or relative performance?'

- No difference, however the base payment changes
- However, if the performance is very good at the beginning of the contract expenditures for performance-based payments may be inefficiently high
- Therefore an absolute payment might be inefficient

Discussion

Implementing performance-based payments - A solution for Eiderstedt?

- Area of the SPA is not sufficient for protection and enhancement of the Black Tern
- No trust in policy/government structures
- Rising opportunity costs because of bioethanol production
- The number of individuals left are too less to built up the population!(?)

Outlook

Implementing performance-based payments - A solution for Eiderstedt?

- In general: Acceptance of performance-based payments
- Implementation of a management plan in 2010 where the combination of performance-based and action-based payments are scheduled
- Gathering knowledge about ϕ – survey among farmers
- Gathering knowledge about η – economic experiments with farmers

Thank you for your attention!