Eksempel på IMRAD-strukturen

Dette eksempel bygger på den videnskabelige artikel *Cold-acclimation increases the predatory efficiency of the aphidophagous coccinellid Adalia bipunctata* (Sørensen & Kristensen, 2013, s. 87-94). Indholdet er udarbejdet af Tine Wirenfeldt Jensen.

INTRODUKTION

- Indeholder en problemformulering og opstiller evt. en hypotese. Beskriver tydeligt et formål ved at forklare, hvorfor det er vigtigt at besvare problemformuleringen/teste hypotesen.
- Sætter problemformuleringen/hypotesen ind i en større sammenhæng ved at inkludere alle relevante baggrundsoplysninger og henvisninger til eksisterende litteratur.

Eksempel:

Predaceous ladybirds (family Coccinellidae) have **received attention from ecologists**, because of their use in biological control as predators of agricultural pests e.g. aphids, diaspids, coccids, aleyrodids and mites (Obrycki and Kring, 1998; Omkar and Pervez, 2005). They have been used as a component of integrated pest management and in augmentative control programs since the early 20th century (Hodek, 1970). Today, ladybirds are commercially produced and sold as bio-control agents, in particular against aphids which damage for billions of dollars of crops annually worldwide (Oerke, 1994). *Adalia bipunctata* (L.) is one of the best studied ladybirds due to its potential use against aphid pests and because it is one of the most common aphidophagous predators in arboreal habitats of Europe and Central Asia (Hodek and Hoňek, 1996). Because *A. bipunctata* is used in augmentation biocontrol programs, **it is of interest to optimize its efficiency against aphid pests.**

The aim of this study was to test the effects of acclimation to three different developmental temperatures in a common aphidophagous predator, *A. bipunctata*. **To fulfill this objective**, we examined the ability of ladybirds, previously acclimated to developmental temperatures of 15, 20 or 25 °C, to consume aphids at four different temperature regimes (constant 15, 20 or 25 °C and one at fluctuating temperatures with a mean of 8.5 °C). We concentrate on responses to low acclimation temperatures since this is most representative for outdoor thermal conditions that are prevailing in Central and Northern Europe. The ability of *A. bipunctata* to control aphids was tested using a microcosm design which partly simulates the complex habitat structure of a cereal field. Furthermore, we tested acclimation effects on heat resistance in order to determine whether or not acclimation to low temperatures entails costs in terms of reduced ability to withstand high temperatures. Developmental effects of the temperature treatments were also investigated by scoring pupal survival and the mass of the adult ladybirds.

We hypothesized that **(1)** developing at a particular temperature enhances the predatory performance of ladybirds in terms of an increased feeding rate on aphids at that temperature (according to the beneficial acclimation hypothesis); **(2)** that acclimation to low temperatures imposes a cost to the ladybirds in the form of reduced heat resistance; **(3)** that there is an association between developmental temperature and body-size with beetles maturing to larger sizes at lower developmental temperatures, as found in many other studies (e.g. Alpatov, 1930; Azevedo et al., 2002) and **(4)** that pupal survival is highest at 25 °C since this temperature is considered optimal for the species (Schüder et al., 2004). **We confirmed all four hypotheses** and **discuss the implications** of our results for the application of ladybirds as bio-control agents in different thermal environments and for the efficiency of biological control systems in general.

METODE

- Fremgangsmåden forklares omhyggeligt og valget af fremgangsmåde begrundes.
- Illustrationer anvendes hvor det er passende, og de er omhyggeligt udført og præsenteres i teksten.

Eksempel:

For estimating heat resistance, **a knockdown test** was used (see e.g. Kellett et al., 2005). Thirty adult ladybirds (15 males and 15 females) from each acclimation temperature were taken directly from the predatory performance experiment and tested. Only individuals that had experienced the same temperature during rearing and predation test were used (Table 1). The ladybirds were placed individually in 5 mL glass vials and exposed acutely to 43 °C by immersion in a preheated water bath. Initially the high temperature exposure caused the ladybirds to become very active, but soon they became increasingly lethargic. Heat knockdown time was scored as the time it took for individual ladybirds to lose muscular function. Movement of the mouthparts, in particular the palps, mandibles and labium, was used to determine muscular function as these were the last body parts to cease moving. In order to distinguish lethargy from inactivity a flashlight and a steel tapping-pole were used to stimulate movement during inspections. Each ladybird was inspected at least every minute.

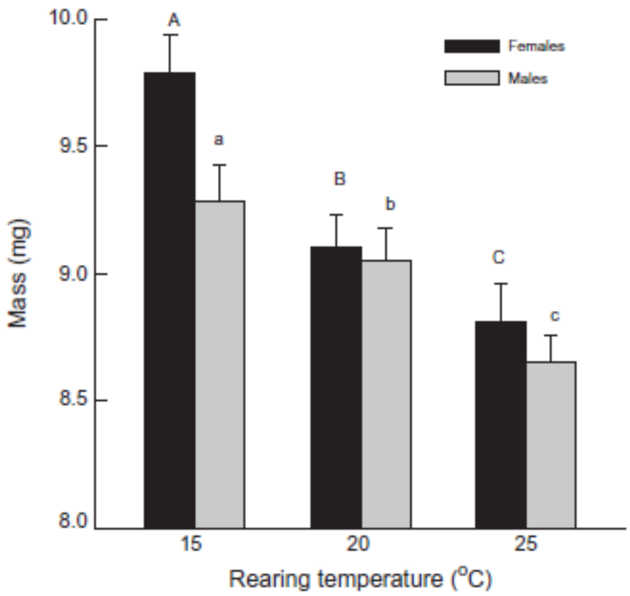

Fig. 4. Mean live mass + SE of adult ladybirds reared at different temperatures. The animals were derived from the constant temperature experiment. Different letters indicate a significant difference between treatments. Capital letters are used for females and lower case letters are used for males.

RESULTATER/ANALYSE

- Centrale fund/resultater beskrives tydeligt og præsenteres korrekt, læsbart og uden mangler eller fejl.

Eksempel:

The effect of rearing temperature on heat resistance was highly significant ($F_{2,84} = 26.50$, $P < 0.001$) while the effect of sex was not ($F_{1,84} = 0.01$, $P = 0.91$). The interaction between rearing temperature and sex was not significant ($F_{2,84} = 0.33$, $P = 0.71$). Increasing rearing temperature increased adult heat resistance, although a significant difference could only be observed between ladybirds reared at 15 °C and those from the other two temperature regimes (Fig. 5). Ladybirds reared at 15 °C had 39.8% and 33.6% lower heat resistance compared to ladybirds reared at 25 and 20 °C, respectively.

DISKUSSION

- Konklusioner fremsættes så de hænger logisk sammen med data.
- Konklusioner forholder sig til problemformuleringen/hypotesen og introduktionen.
- Implikationer og potentielle problemer diskuteres grundigt.

Eksempel:

We detected several costs associated with cold acclimation. The relative predatory performance of cold-acclimated ladybirds was reduced at higher test temperatures (Figs. 1 and 2, Graphical Abstract), and developing at low temperatures decreased pupal survival (Fig. 3) and reduced tolerance to high temperatures (Fig. 5). **Costs** of cold acclimation **are commonly observed** both in laboratory and field studies on ectotherms (Basson et al., 2012; Chidawanyika and Terblanche, 2011; Kristensen et al., 2008; Thomson et al., 2001). **Benefits** of cold acclimation in some traits sometimes entail a trade-off by costs in other traits, and studies of cost and benefits of acclimation have provided insight into the evolution of plasticity and may partly explain why selection does not always favour higher plasticity (Chevin et al., 2010). The difference in pupal survival at low and higher developmental temperatures **could be explained** by the inability of cold acclimated larvae to gather enough energy to complete the pupation process.

Our results showed that ladybirds acclimated to the temperature at which they were tested, performed significantly better, in terms of consuming aphids, compared to ladybirds acclimated to a different thermal environment**. Hence, producers of bio-control agents should pay more attention to** their rearing conditions so that e.g. rearing temperatures to a larger extent mimic those that the bio-control agent is expected to perform under. This study demonstrated the potential value and practical feasibility of thermal acclimation for counteracting reduced predation efficiency at field temperatures below those that are optimal in the laboratory. **The results are therefore of critical importance** to ladybird–aphid bio-control systems and have broad applicability to other pest management programs which employ natural enemy release methods to suppress pests.