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Ecological traps for dragonflies in a cemetery: the attraction of *Sympetrum* species (Odonata: Libellulidae) by horizontally polarizing black gravestones

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SUMMARY

1. We observed that the dragonfly species *Sympetrum flaveolum*, *S. striolatum*, *S. sanguineum*, *S. meridionale* and *S. danae* were attracted by polished black gravestones in a Hungarian cemetery.
2. The insects showed the same behaviour as at water: (i) they perched persistently in the immediate vicinity of the chosen gravestones and defended their perch against other dragonflies; (ii) flying individuals repeatedly touched the horizontal surface of the shiny black tombstones with the ventral side of their body; (iii) pairs in tandem position frequently circled above black gravestones.
3. Tombstones preferred by the dragonflies were in the open and had an area of at least 0.5 m^2 with an almost horizontal, polished, black surface and with at least one perch in their immediate vicinity.
4. Using imaging polarimetry, we found that the black gravestones, like smooth water surfaces, reflect highly and horizontally polarized light.
5. In double-choice field experiments with various test surfaces, we showed that the dragonflies attracted to shiny black tombstones display positive polarotaxis and, under natural conditions, detect water by means of the horizontally polarized reflected light. This, and the reflection-polarization characteristics of black gravestones, explain why these dragonflies are attracted to black tombstones.
6. If females attracted to the black gravestones oviposit on them, the latter constitute ecological traps for dragonflies that are not close to water.

Keywords: black gravestones, ecological trap, Odonata, polarization vision, water detection

Introduction

Dragonflies (Odonata) are strongly associated with water because their larvae are aquatic (Corbet, 1999). After emergence, the young imagines generally leave the water during a maturation period and return to it for reproduction. For most species, waterbodies with visible surfaces are places where the sexes encounter each other and where females oviposit. Remarkable exceptions to this natural behaviour occur at certain artificial surfaces, such as plastic sheets, perspex panels, pools of crude or waste oil and car bodies (Wildermuth & Spinner, 1991; Wildermuth, 1993, 1998; Horváth & Zeil, 1996; Horváth, Bernáth & Molnár, 1998; Bernáth *et al*., 2001; Wildermuth & Horváth, 2005).

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Here a similarly unusual behaviour is reported from a Hungarian cemetery. We observed that dragonflies of various *Sympetrum* species were attracted by particular black gravestones at which they displayed the same behaviour as at water surfaces. It has been shown that some dragonfly species are polarotactic (Horváth *et al*., 1998; Wildermuth, 1998), that is they detect water by means of the horizontally polarized light reflected from the surface. Therefore, they can be deceived by any surface with similar polarization features. Here, we measured the reflection-polarization characteristics of tombstones. In addition, we performed choice experiments in the field to test whether the *Sympetrum* species apparently deceived in the cemetery are polarotactic. Our main question was whether the dragonflies observed in the cemetery are polarotactic or not. Positive polarotaxis could explain their attraction to horizontally polarizing gravestones. We also investigated the conditions under which the gravestones attracted dragonflies and whether the former could be acting as ecological traps, *sensu* Schlaepfer, Runge & Sherman (2002), for polarotactic dragonflies.

Methods

The field site was a cemetery in the Hungarian town of Kiskunhalas (46°43′N, 19°05′E). This old cemetery was rather densely overgrown by trees and bushes and thus, from spring to autumn, the majority of tombstones were shaded by trees. Next to roads through the cemetery, however, the gravestones were often unshaded. Although there were several garden taps in the cemetery, there were no ponds or other water surfaces. The nearest natural waterbodies were small alkaline lakes (with an area of about 20 × 30 m) about 2 km from the cemetery. Of the dragonflies found at these lakes, including species of the families *Aeshnidae*, *Corduliidae* and *Libellulidae*, only *Sympetrum* spp. visited the cemetery.

The reflection-polarization characteristics of gravestones were measured on 28 July 2005 by videopolarimetry according to Horváth & Varjú (1997). The polarization patterns of tombstones were measured in the red (650 ± 40 nm, the wavelength of maximal sensitivity ± half bandwidth of the CCD detectors of the polarimeter), green (550 ± 40 nm) and blue (450 ± 40 nm) parts of the spectrum. As these patterns were practically independent of the wavelength of light, because the tombstones were colourless, we present here only the patterns measured in the green spectral range. The elevation angle of the optical axis of the polarimeter was −30° from the horizontal. The gravestones were either shaded by trees, or in direct sunlight.

Double-choice experiments with *Sympetrum* species were performed on 24–26 June and 6–9 July 2006. The exact times (local summer time, which was Greenwich main reference time plus 2 h) of the beginning and the end of each double-choice experiment are given in Results. During all experiments the weather was warm and sunny with a clear sky. Each double-choice experiment was performed at the same place, where two perpendicular grassy paths intersected. In a given choice experiment two test surfaces, each with an area of 1 × 1 m, were laid horizontally onto the ground at a distance of 1 m from each other. One of them was always a wooden board covered by a shiny black plastic sheet that was tested against a second board with different covering material in each experiment: (i) a shiny white (non-transparent) plastic sheet; (ii) aluminium foil; (iii) matt black cloth and (iv) matt white cloth. In the last experiment, as a control, both test surfaces consisted of the same matt light brown wooden board.

The reflection-polarization characteristics of these test surfaces were measured by videopolarimetry in an earlier field experiment (Horváth *et al*., 1998). Depending on the direction of reflection, the test surfaces with smooth and shiny surfaces (plastic sheets and aluminium foil) reflected light with a lower or higher degree of linear polarization (p). The degree of polarization (p) of reflected light was highest at the Brewster's angle (about 38° from the horizontal). When characterizing the degree of linear polarization of light reflected from a surface, we always refer to the p-value measured at Brewster's angle: (i) the horizontal shiny black plastic sheet reflected highly ($p \leq 90\%$) and horizontally polarized light; (ii) the horizontal shiny white plastic sheet reflected weakly ($p \leq 20\%$) and vertically polarized light; (iii) the horizontal aluminium foil reflected moderately ($p \leq 45\%$) polarized light with diverse, but usually non-horizontal, directions of polarization and (iv, v, vi) the horizontal matt white cloth, matt black cloth and matt light brown wooden board reflected unpolarized ($p = 0\%$) light.

In double-choice experiments, the positions of the two test surfaces were interchanged hourly. At every corner of each test surface a 30-cm long thin wooden stick was stuck vertically into the ground. These sticks functioned as perches for the dragonflies. Depending on the time of day, the perches were either sunlit or shaded by trees. The behaviour of the dragonflies at the test surfaces was observed continuously from a distance of 3 m. The number, position and illumination (sunlit or shaded) of the dragonflies sitting on the ($2 \times 4 = 8$) perches at the test surfaces were recorded. The duration and number of occurrences of the following five typical behavioural elements were determined: (i) *perching*; (ii) *feeding*; (iii) *attacking*; (iv) *tandem flight* and (v) *touching*. As it is almost impossible to identify some *Sympetrum* species with certainty in the field, we captured 30 specimens that were perched at the test surfaces and preserved them for later examination under the microscope. To compare the data pairs in Table 1, chi-squared tests were performed by means of the computer program STATISTICA 6.1.

Results

From May to August in 2005 and 2006, we noted many dragonflies of several species in the cemetery, even though it lacked any water body. In the course of our behavioural observations and field experiments, five species were identified, all belonging to the genus *Sympetrum*. We found *S. flaveolum* (Linnaeus, 1758), *S. striolatum* (Charpentier, 1840), *S. sanguineum* (Müller, 1764), *S. meridionale* (Selys, 1841) and *S. danae* (Sulzer, 1776), of which both sexes were present, most of them being mature and reproductively active, although there were some juveniles. As *Sympetrum* spp. cannot reliably be identified to species without disturbing their natural behaviour, we did not attempt to distinguish between them during behavioural observations and experiments. In general, all species apparently exhibited very similar behaviour. They perched on sunlit dry branches of trees and bushes, or on the top of the iron railings surrounding

Table 1 The reactions of *Sympetrum* species in a double-choice experiment towards a pair of horizontal test surfaces comprising a shiny black plastic sheet (1 × 1 m) and another test surface (1 × 1 m) as a control: (a) aluminium foil, (b) shiny white plastic, (c) matt white cloth, (d) matt black cloth

	Perching time t (min)		Number (n) of behavioural events			
Test surface	Sunny	Shady	Feeding	Attack	Tandem	Touching
(a) Day.month.year, time (UTC + 2): 24.06.2006, 14:45–17:45 & 25.06.2006, 09:25–13:00 duration of the experiment T = 395 min						
Shiny black plastic sheet	798*†	315*	47	211*	37*	25*
	Sum = 1113*					
Aluminium foil	290†	122	52	27	0	0
	Sum = 412					
(b) Day.month.year, time (UTC + 2): 25.06.2006, 14:30–18:26 & 26.06.2006, 09:00–12:50 duration of the experiment T = 466 min						
Shiny black plastic sheet	1011*†	395*	63	251*	50*	25*
	Sum = 1406*					
Shiny white plastic sheet	430†	137	67	42	0	0
	Sum = 567					
(c) Day.month.year, time (UTC + 2): 06.07.2006, 13:50–17:25 & 07.07.2006, 08:55–12:37 duration of the experiment T = 437 min						
Shiny black plastic sheet	557*†	130*	59	236*	47*	28*
	Sum = 687*					
Matt white cloth	181†	16	61	39	0	0
	Sum = 197					
(d) Day.month.year, time (UTC + 2): 07.07.2006, 14:15–18:30 & 08.07.2006, 09:00–13:00 duration of the experiment T = 495 min						
Shiny black plastic sheet	499*†	190*	169	392*	81*	22*
	Sum = 689*					
Matt black cloth	81†	16	143	33	0	0
	Sum = 97					

The perching time t is the sum of the periods spent by all individuals on the perches at a given test surface during the experiment. t was measured separately for sunny and shady perches. T is the duration of the experiment and n is the number of behavioural events. Comparing the vertically aligned data pairs belonging to any two test surfaces, a value marked by * is statistically significantly larger (χ^2-test, $P < 0.001$) than the corresponding one on the other surface. Comparing the horizontally aligned data pairs belonging to the sunny and shady perches, the value marked by † is statistically significantly larger (χ^2-test, $P < 0.001$) than that on the other surface.

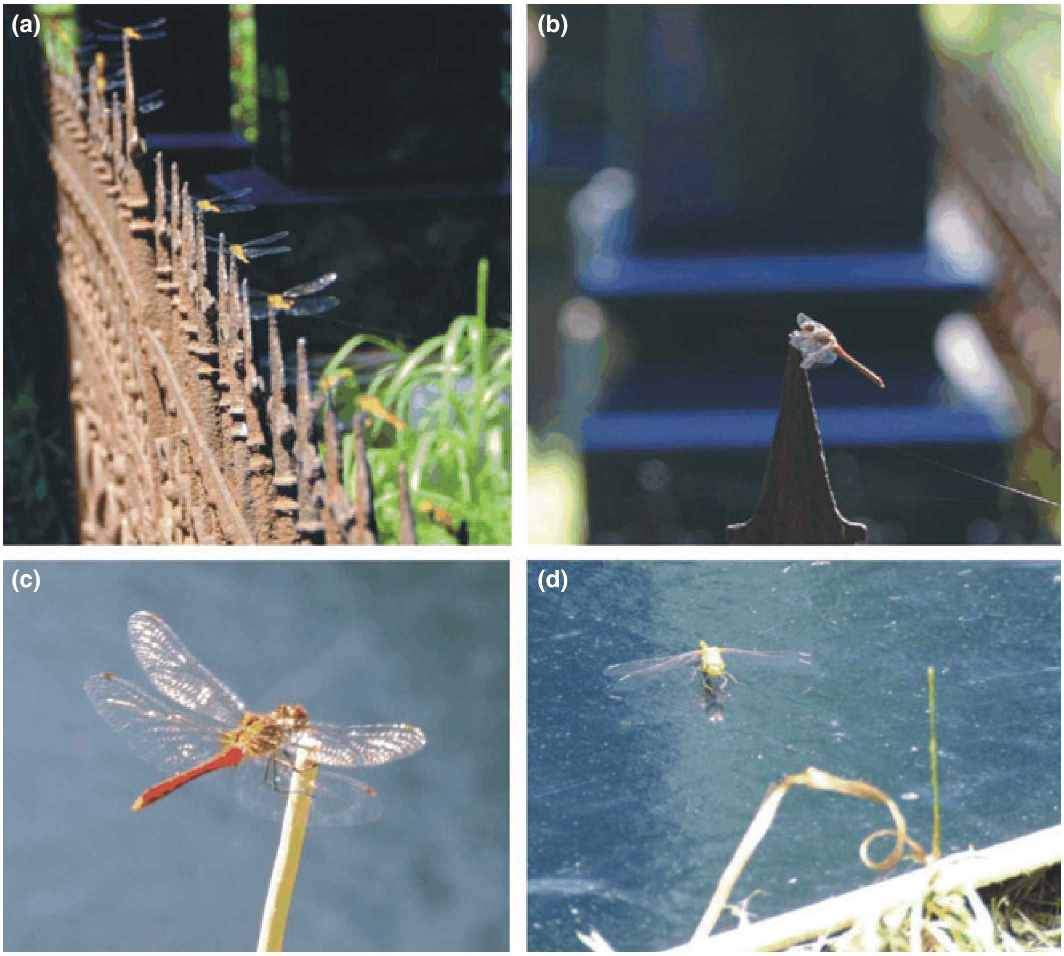

Fig. 1 (a) Male and female dragonflies (*Sympetrum* sp.) perching on the tips of sunlit iron railings in a cemetery in the Hungarian town Kiskunhalas. (b, c) Males of *Sympetrum* sp. perching near polished black tombstones. (d) A female *Sympetrum* sp. displaying touching behaviour at the shiny black plastic sheet used in the double-choice experiments. The photo shows the brief moment when she touches the test surface with her legs and ventral side of her body.

particular gravestones (Fig. 1a,b). Most frequently they stayed in the immediate vicinity of shiny black gravestones, but sometimes they were also seen near those that appeared matt grey/white or shiny grey/white to the human observer. Above horizontally aligned polished black tombstones some individuals flew to and fro for several tens of seconds, repeatedly touching briefly the tombstone's surface with the ventral side of their body (10–30 times). In addition, pairs in tandem position were often seen to fly in loops above black tombstones. Touching behaviour and tandem flights were only observed at polished black or dark grey gravestones, never on other types.

These observations suggested that the dragonflies were strongly attracted under the following conditions: (i) the tombstone had a surface which was black or dark grey, polished, and near horizontal, and an area of at least 0.5 m^2; (ii) the gravestone was not overhung by trees; (iii) there was at least one perch in the immediate vicinity. Examples of the reflection-polarization patterns of gravestones that attracted dragonflies are shown in Figs 2 & 3. Gravestones reflected strongly and nearly horizontally polarized light if their surface was shiny, black and approximately horizontal. The direction of polarization of light reflected from a tombstone was always perpendicular to the plane of reflection, i.e. it was horizontal if the gravestone's reflecting surface was horizontal and the light was coming from above. In contrast to the shiny horizontal surface of black tombstones, the surrounding vegetation reflected only weakly or moderately polarized light (with low or medium

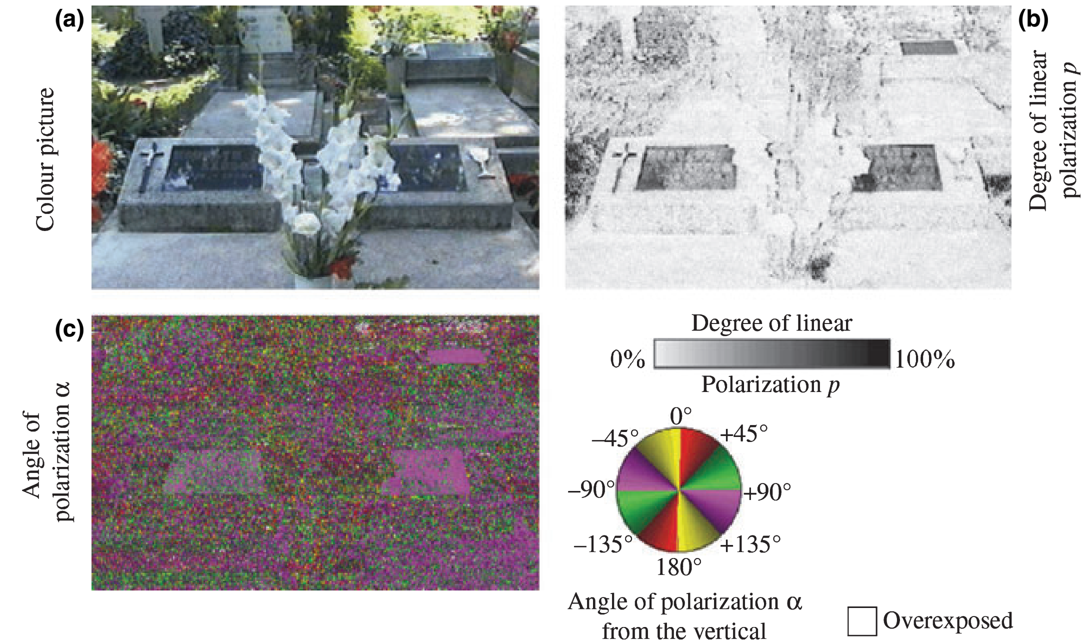

Fig. 2 (a) Concrete gravestones with horizontal, polished, black name-plates (two in the middle and one in the top right corner). The tombstones were in shadow and illuminated by downwelling skylight. (b, c) Patterns of the degree of linear polarization p and angle of polarization α (relative to the vertical) of the tombstones measured by imaging polarimetry in the green (550 ± 40 nm) part of the spectrum. The angle of elevation of the optical axis of the polarimeter was –30° with respect to the horizontal.

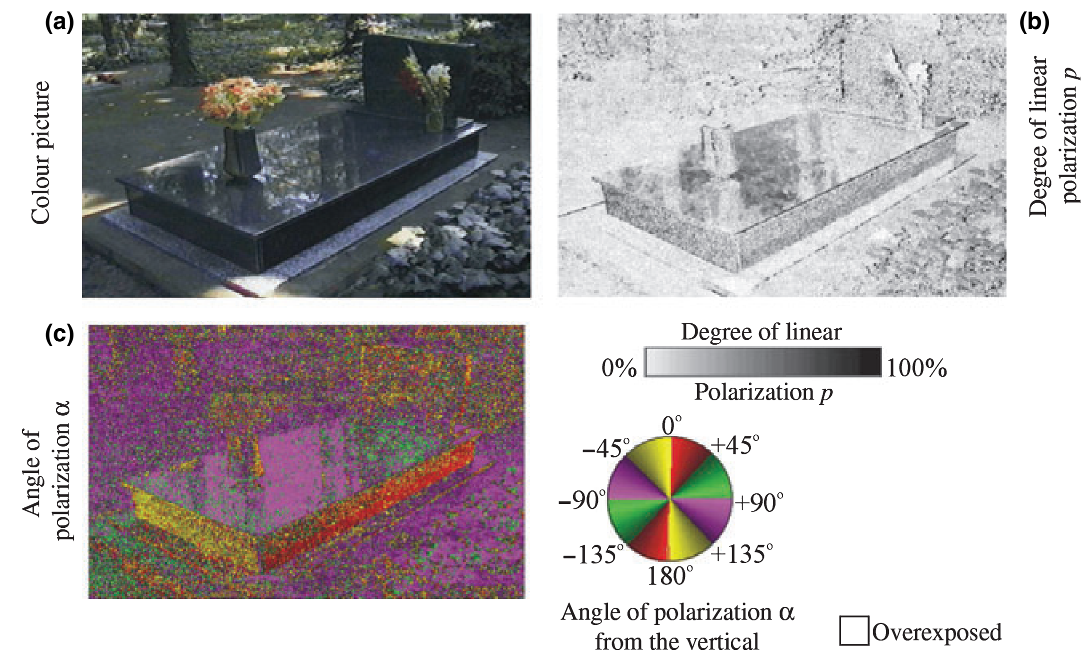

Fig. 3 As Fig. 2 for a horizontal black polished gravestone in the shade of trees, illuminated by light from a clear sky.

degrees p of linear polarization), the direction of polarization of which was random because of the random orientation of the leaf blades. There were often light grey matt concrete gravestones, with horizontal polished black name-plates with an area of about 0.5 m^2 reflecting strongly and horizontally polarized light (Fig. 2). The concrete itself reflected light with very low *p* and usually non-horizontal polarization. Consequently, it was unattractive to polarotactic dragonflies. Figure 3 shows a black gravestone, the whole surface of which was polished and thus highly polarizing (Fig. 3b). The horizontal and vertical surfaces reflected horizontally and vertically polarized light, respectively (Fig. 3c). Figure 4 represents a vertical black gravestone with a polished surface. Although the shiny surface was strongly polarizing (Fig. 4b), the light reflected from the vertical surface parts was vertically polarized (Fig. 4c), because in this case the plane of reflection was horizontal. Similar polarimetric measurements showed that other kinds of gravestone with matt and/or bright and/or non-horizontal surfaces reflect light with low degrees of linear polarization and/or with non-horizontal direction of polarization. In all five *Sympetrum* species attracted by certain gravestones and by our test surfaces the following five behavioural elements were distinguished:

1 *Perching*: The dragonflies simply sat on the tip of a perch (Fig 1b,c), their posture depending on the ambient temperature (a basking or 'obelisk' posture, the latter meaning that the insect's abdomen points to the sun). Sometimes they adjusted the direction of their body axis.

2 *Feeding*: Starting from the perch the dragonflies made short steep sallies dashing towards small flying insects (usually dipterans), then returned to the perch.

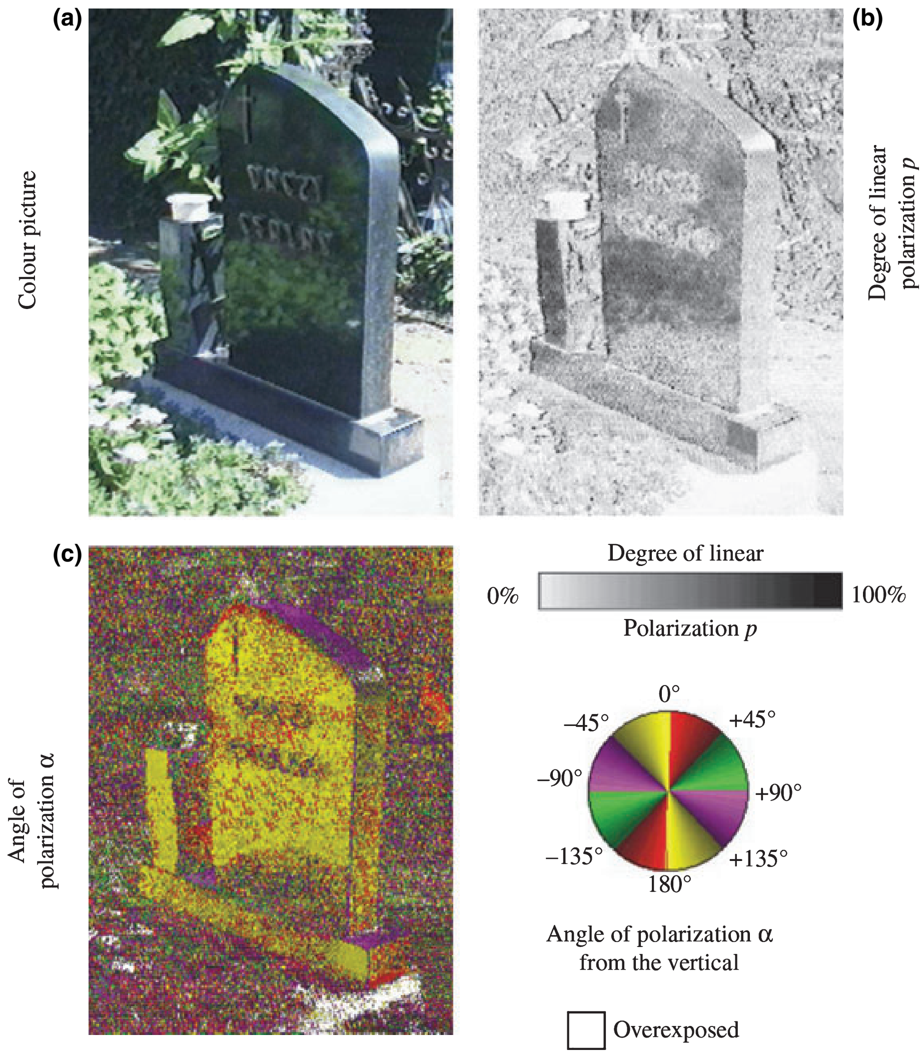

Fig. 4 As Fig. 2 for a sunlit black polished gravestone in vertical position with its frontal side in shade and illuminated by the light from the clear sky.

These hunting events lasted about 2 s, although sometimes the prey was chased for a few extra seconds.

3 *Attacking*: When other dragonflies appeared at the site above dark grey or black gravestones or the test surfaces, the observed individual attacked them. Sometimes, if the approaching dragonfly was a female and the perching dragonfly was a male, the latter tried to copulate. Otherwise, the resident tried to drive away the intruder. After every attack the dragonfly returned to its perch. These attacks lasted a few seconds.

4 *Tandem flight*: This behaviour comprised mid-air tandem formation by males starting from the perches as well as in-tandem oviposition movements above the substrate surfaces typical for *Sympetrum* species. These tandem flights lasted 20–120 s. Sometimes the pairs perched nearby the shiny dark grey or black gravestones and the shiny black test surface in tandem position for 20–300 s.

5 *Touching*: The dragonflies flew to and fro above the shiny black plastic sheet and the dark grey or black gravestones for 20–60 s shortly touching the substrate surface 10–30 times with the ventral side of their body (Fig. 1d).

The reactions of the dragonflies towards various test surfaces used in the double-choice experiments are given in Table 1, differentiated according to the five behavioural elements described above. The perching time t was often longer than the duration T of the experiment, because frequently more than one dragonfly (maximum of four) perched at the test surface. Depending on the test surface, the dragonflies perched 2.3–11.3 times longer in the sun than in the shade, which is a statistically significant difference (χ^2-test, $P < 0.001$). At the shiny black plastic sheet, the total perching time was 2.5–7.1 times longer than at all other test surfaces, which is again statistically significant difference (χ^2-test, $P < 0.001$). However, there were no statistically significant differences in the number of feeding events between the shiny black plastic sheet and any other test surface (χ^2-test, $P > 0.1$). On the other hand, the number of attacks was 6.0–11.9 times higher at the shiny black plastic sheet than at the other test surfaces, which is again statistically significant difference (χ^2-test, $P < 0.001$). Both tandem flights and touching were observed only at the black plastic. There were no statistically significant differences in dragonfly behaviour between the two uniform (matt light brown wooden boards) test surfaces (χ^2-test, $P > 0.45$). Thus, there was no inherent bias in the location of the two test surfaces used in the double-choice experiments.

Discussion

At the Kiskunhalas cemetery many dragonflies in five *Sympetrum* species were present and exhibited basking, foraging and reproductive activities. Reproductive behaviour was concentrated at sites in the immediate vicinity of horizontally aligned polished dark grey or black gravestones, the polarization features of which greatly resembled those of water surfaces. Why did certain behavioural elements apparently occur at randomly distributed sites while others were limited to dark grey or black tombstones?

Perching sites, such as dry branches and the leaf tips of plants or iron railings around tombstones (Fig 1a,b), were present everywhere in the cemetery. However, the dragonflies usually preferred the immediate vicinity of dark grey or black shiny tombstones. From these observations we conclude that the behaviour of both sexes of the dragonflies was governed by feeding or sex. Mature males that took up sites at dark grey or black gravestones were probably mainly seeking matings as they clearly exhibited reproductive behaviour, although they were feeding too. As reported for *Sympetrum striolatum*, hunting from a perch near water often occurs (e.g. Oehme, 1999). On the other hand, immature individuals, and possibly also mature females, used the perches for basking and feeding only. It is not clear if some of those that arrived at gravestones were seeking to oviposit. All dragonflies definitely preferred sunny perches. This finding was supported experimentally in our double-choice experiments, in which the insects spent significantly more time on sunlit sticks at the test surfaces than at the shaded ones, independently of the underlying test surface (Table 1). This corresponds to the general rule that ectothermic dragonflies, for thermoregulatory reasons, usually prefer sunlit places (Corbet, 1999, pp. 285–291). This enables quick starts for sallies towards prey or approaching conspecifics (Moore, 1991; Oehme, 1999). Our double-choice experiment, using two uniform matt test surfaces, clearly showed that the dragonflies attracted displayed the same behavioural elements, such as perching, feeding and attacking, as at perching places away from water and anywhere in the cemetery.

Most remarkable is the behaviour of *Sympetrum* species at perching sites above the horizontal surfaces of polished black gravestones, the reflection-polarization characteristics of which were exactly imitated by horizontal shiny black plastic sheet. Dragonflies frequently touched the horizontal surface of dark grey or black gravestones, as they would the water surface under natural conditions (Corbet, 1999, p. 19). When this touching occurred only at shiny dark grey or black tombstones, we conclude that *Sympetrum* species mistook the horizontal surface of these gravestones for water. A similar behaviour was reported by Günther (2003) in *S. vulgatum*, a female (in tandem) of which laid about 50 eggs on the metallic-green bonnet of a car. Furthermore, *S. striolatum* was seen to oviposit on an old plastic windscreen thrown into a chalk pit and on glass panels of a tractor door that was left laid flat on grass. When the door was placed in an upright position the dragonflies lost their interest in it (Paine, 1992). Jurzitza & Kormann (1960) observed that females in tandem pairs of *Sympetrum* (*striolatum* or *vulgatum*) oviposited onto nearly horizontal glass panes in a botanic garden.

From the results of our choice experiments (Table 1) it was obvious that the shiny black plastic sheet, similar to the reflection-polarization characteristics of the horizontal parts of shiny black gravestones, was much more attractive to dragonflies than the other test surfaces. Note that only the shiny black plastic sheet reflected highly and horizontally polarized light, the other test surfaces reflected unpolarized or non-horizontally polarized light. As the shiny black plastic was much more attractive than matt black cloth, simple negative phototaxis (i.e. an attraction to dark surfaces) could not explain our findings. Because the shiny black plastic was much more attractive than the shiny white plastic, the matt white cloth and the aluminium foil, positive phototaxis was also excluded. Hence, we conclude that the *Sympetrum* species observed are polarotactic, as are many other aquatic insects (Schwind, 1991; Horváth & Varjú, 2003; Csabai *et al.*, 2006; Kriska *et al.*, 2006).

Our imaging polarimetric measurements and double-choice experiments demonstrated that the physical and physiological reasons for the attraction of dragonflies to dark grey or black tombstones are that: (i) these *Sympetrum* species possess positive polarotaxis, i.e. they detect water by means of the horizontally polarized reflected light and (ii) only the polished dark grey or black gravestones reflect strongly and horizontally polarized light. Matt and/or bright tombstones reflect weakly and/or non-horizontally polarized light. Positive polarotaxis in several other dragonfly species has been demonstrated in earlier field experiments (Horváth *et al.*, 1998; Wildermuth, 1998; Bernáth *et al.*, 2001), in which it was also shown that these insects detect water by the horizontal polarization rather than by the intensity and/or colour of reflected light.

Our experiments suggest that if *Sympetrum* dragonflies can choose between a strongly and horizontally polarizing surface (e.g. polished dark grey or black tombstone, or shiny black plastic sheet) and a weakly and non-horizontally polarizing one (e.g. matt and/or bright tombstone, or shiny white plastic sheet, matt white/black cloth, aluminium foil), they always prefer the former. This preference manifests itself not only by the total perching time, but also by the numbers of tandem flights, touching and attacking events (Table 1). Notably, tandem flights and touching were seen only at the shiny black plastic sheet. This supports experimentally our observation of strong attraction of dark grey or black gravestones for sexually active dragonflies.

Attacks from perches occurred at all test surfaces, but their frequency was significantly higher at the shiny black plastic sheet (Table 1). Hence, the insects defended their site more intensely if the perch was at the shiny black plastic sheet. This again supports the conclusion that the highly and horizontally polarizing black plastic sheet and dark grey or black gravestones were mistaken for water by sexually active *Sympetrum* individuals in search of rendezvous sites. Notably, the weakly and/or non-horizontally polarizing test surfaces (shiny white plastic, aluminium, matt black/white cloth) were only 1 m apart from the strongly and horizontally polarizing shiny black plastic sheet. Thus, some of the perches at these test surfaces could have belonged to the area protected more intensely by the dragonflies perching at the shiny black plastic sheet. These often drove away the individuals perched at the adjacing test surface.

According to our polarimetric measurements, the smoother and/or the cleaner was the surface of a gravestone, the higher was the degree of linear polarization p of reflected light. Further, the darker was a tombstone, the higher was the *p* of the reflected light. Horizontal surfaces reflecting light with a higher *p*-value were more attractive to polarotactic dragonflies than less polarizing surfaces (Horváth *et al*., 1998; Bernáth *et al*., 2002). The same is true for polarotactic aquatic beetles, water bugs and mayflies (Horváth & Varjú, 2003). This explains why *Sympetrum* individuals were most often attracted to black gravestones with smooth, polished and clean surfaces. Although their reflection-polarization characteristics depend on the illumination conditions, the horizontal surface parts of both sunlit and shaded black tombstones reflect always horizontally polarized light. Therefore, both sunlit and shaded gravestones can attract *Sympetrum* species, if they reflect horizontally polarized light.

Sympetrum males, belonging to the 'percher' type *sensu* Corbet (1999, p. 283) and waiting for females near water, need a place from where they can overlook the surroundings. This explains our observation that the existence of at least one perch in the immediate vicinity of gravestones was a pre-requisite for the sustained presence of *Sympetrum* males.

Sympetrum dragonflies recognize each other or their prey most easily from below, i.e. when the target shows against the sky as a uniform and bright background (Labhart & Nilsson, 1995). This could explain why the dragonflies mostly choose gravestones without overhanging foliage. Another reason may be that perches near a gravestone in the open are more likely to be sunlit (and therefore desired) than those under trees.

Black horizontally aligned tombstones that are surrounded by low vegetation (Fig. 1b,c, Figs 2 & 3 mimic well the optical characteristics of open waterbodies, each not larger than a few square metres. They typically attract dragonflies such as certain *Sympetrum* species that preferentially breed in small bodies of still water. Therefore, black gravestones may elicit oviposition. Actual and attempted egg-laying by dragonflies onto horizontal shiny dark surfaces, such as car bodies, pools of oil or asphalt roads, has repeatedly been observed (for review see Horváth *et al*., 1998; Wildermuth, 1998; Horváth & Varjú, 2003). All these man-made substrata may constitute ecological traps *sensu* Schlaepfer *et al.* (2002), thus reducing the insect's individual fitness. The same is true for certain gravestones even though cemeteries are often situated far away from wetlands. However, those of them with black gravestones may attract dragonfly species, especially *Sympetrum* that rove about in search of small waterbodies for reproduction. Although the dragonflies observed here were numerous and presumably stayed for sometime in the cemetery, it is not known to what degree their reproductive success was diminished. The breeding sites of *Sympetrum* often consist of temporary pool and, to minimize the risk of complete failure, they might habitually oviposit at a number of sites. On the other hand, the deception of *Sympetrum* species by gravestones in the cemetery at Kiskunhalas is not unique. In fact, it has also been noticed in the Jewish graveyard of Sopron (Hungary) and in the cemetery of Teichland (Brandenburg, Germany) with *Sympetrum depressiusculum* involved (Tomy Gottfried, pers. comm). The ecological relevance of strongly and horizontally polarizing man-made substrata that deceive reproductively active Odonata depends on the availability of suitable waterbodies and the density of trap areas in a landscape.

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