Struggle for safety

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Box I

Trial and Error

Why don’t you find as much ‘Wadden Sea’ in this thesis as you would perhaps have expected? It is not because no fieldwork was done in the Dutch Wadden Sea. Actually, quite some time and effort was spent on fieldwork here, and several colleagues, students and other volunteers participated in this. Although several student reports (by Jutta Leyrer, Jeroen Reimerink and Rob van Bemmelen) emerged from this field work, as yet Banc d’Arguin studies were given priority for scientific publications. Bringing together the results from our studies on raptor-shorebird relationships in the Wadden Sea has been deferred and not presented in this thesis. A short exposé of our study efforts should explain how this came about. It also illustrates the mistakes, the hooks and eyes, and other incidents that may accompany a research project, particularly in its early stages.

Just preceding this PhD-project, in August and September 2002, Jutta Leyrer (a trainee then and a colleague at present) and I set out to explore possible relationships between predation danger and several attributes of foraging, such as intake rates, flock size, inter-bird distance and time budgets. We started our activities on the mudflats surrounding the island of Griend in the western Wadden Sea (53°15′ N, 05°15′ E) where most of the studies on Red Knots in the Dutch Wadden Sea had been executed (e.g. Piersma *et al.*, 1993, Nebel *et al.*, 2000). At this point in time, with hindsight not surprisingly (Kraan *et al.*, 2009), we could hardly find any Red Knots. At most a few hundred individuals were spotted on the mudflats around Griend. At the same time, about 20 000 individuals were reported foraging on the mudflats surrounding the eastern part of the island of Schiermonnikoog (53°30′ N, 06°22′ E), in the eastern part of the Dutch Wadden Sea, so we moved to Schiermonnikoog. Although we were able to observe the Red Knots here, we were unable to connect these observations to measures of varying predation danger, for the simple reason that their main predator, the Peregrine Falcon *Falco peregrinus* was never observed on the offshore mudflats where we did our foraging observations. Peregrines were only now and then seen nearshore, particularly near the main shorebird roost (just as we later would observe at Banc d’Arguin – Chapter 4). In contrast to Red Knots in the Wadden Sea, Red Knots wintering at Banc d'Arguin turned out to be much more site-faithful with small home ranges (Leyrer *et al.*, 2006). This allowed for repeatable observations of individuals, and better opportunities to observe their interactions with the several falcon species that hunted them. In other words, the entire scenario of raptor-shorebird interactions unfolded itself in a relatively small area, which in winter appeared to be a virtually closed system. Prey remains were easier to find enabling calculations of relative vulnerabilities of species and age-classes. The large home ranges (Piersma *et al.* 1993, van Gils *et al.* 2006) and unpredictable appearance of shorebirds (and predators to a lesser extent) made it much more difficult to perform such investigations in the Wadden Sea. These differences made Banc d'Arguin a far more attractive site for this kind of fieldwork.

A year later, from 30 July –18 September 2003, we studied roost use of radio-tagged Red Knots in the western Wadden Sea. Richel (53°25′ N, 05°35′ E) is a bare sandspit close to Vlieland and one of the key roosting sites for birds foraging in the western part of the Wadden Sea (van Gils *et al.* 2006). We hypothesized that, due to their decreased manoeuvrability, the heaviest birds should show the highest tendency to skip the roost at Richel after having experienced increased predation danger there. We performed our investigations just before Peregrines would arrive from their northerly (e.g. Scandinavian) breeding grounds to their staging or wintering areas in the Wadden Sea. We planned to induce predation danger by controlled raptor intrusions. Yet, as we could not get hold of a falconer and tethered falcon, we used a remote controlled aeroplane instead. We found a dedicated hobbyist who was not only able to fly with a radiographic aeroplane, but who was also skilful in constructing such machines. Sadly, the falcon-like profile he applied to a plane hampered its flying properties causing it to crash in a test flight.

We then decided that a 'standard' small and manoeuvrable radiographic plane should do the job. Although the birds would not perceive the plane as a raptor they would at least experience it as a source of disturbance. (Note that all this intrusive experimental work was carefully planned and vetted by the conservation authorities in the Wadden Sea!). On 5 August, at high tide, we flew the plane towards the roost. We performed four successive flights. The first flight created massive disturbance, inducing flight in all birds. When landing, the shorebirds, and Curlews *Numenius arquata* in particular, more closely packed together then they had previously done. The second and third flight emitted weaker responses, but still a lot of birds left the roost altogether after the fourth flight. In the course of August we added three of such disturbance experiments, each consisting of three or four short successive flights, while recording which birds were present before the intrusion and which individuals returned in the next roosting session.

As the operator of the plane could not continuously be present, and weather conditions not always allowed for flights, we had to take our chances when he was present. As not all radiotagged birds used Richel as a roosting place at all times, sample sizes were often quite moderate (ranging from 4 to 21 birds present) which limited statistical power. This may have been the reason that in the end we did not

Figure I.1 Observation tower in the Wadden Sea. In 2004 Red Knots were kept in wire-netting cages below the observation platform.

find any effects of body mass on the birds' decisions whether to roost again on Richel after being disturbed.

Therefore, the next year we decided to repeat the experiment. To increase detectability of effects we decided to create weight categories ourselves by catching birds, holding them in a pen on the lower deck of our observation tower (Figure I.1), and feeding them with Brown Shrimp *Crangon crangon*, differentiating in feeding ration such that one group would end up as the heavy ones, the other as the light ones. These two groups would then be released and exposed to predation danger while at the roost. Meanwhile we had succeeded in engaging a falconer with a large (and quite lazy) Saker Falcon *Falco cherrug* (Figure I.2) to perform a real predation disturbance job.

Although straightforward at first sight, creating weight classes by differential feeding turned out to be a tough job. Not only was it difficult to keep the shrimps alive (we kept them in large tubs; we added oxygen and kept densities as low as possible), it was plainly impossible to induce birds to put on weight. Although we went to extremes to feed them, all birds tended to lose weight. In the end, birds were released with body masses that were on average 17 g less than their body masses at catch. As we were not able to create two weight classes of birds, we decided, as an alternative treatment, to clip the 7th or 8th primary (ones that they

Figure I.2 Saker Falcon used in the 2004 experiments. Richel (and the island of Vlieland behind it) is on the background.

were about to shed) in half of the birds in order to temporally induce a small flight handicap nevertheless, seeing whether this would influence their roost decision after being exposed by our Saker Falcon. The falcon was released from the observation tower. Rather than attacking or even targeting shorebirds the falcon just flew to the sandspit and perched on the sand. Although shorebirds flew off at its appearance their responses were not as strong as we would witness after appearance of a wild Peregrine (this fitted the threat-sensitive predator avoidance hypothesis which we would later demonstrate in an experimental context – Chapter 8). Still, hardly any of the birds returned at all to the roost the following days leaving us with virtually no data!

Unfortunately, sensible insights often come with hindsight. For instance, it is likely that by keeping Red Knots in captivity we were actually imposing a predation danger treatment upon them. The fact that the birds kept their body masses low no matter how hard we tried to stuff them with shrimps (a high quality food source, indeed), may, next to other possible stress factors, well have been the reflection of an anti-predation measure (see, for instance, Chapter 9)! Besides, even if we would have managed to create a differentiation in weight classes, we should have been prepared for the possibility that birds adjust pectoral muscle to changes in wing loading in order to maintain flight performance (Chapters 8 and 9).

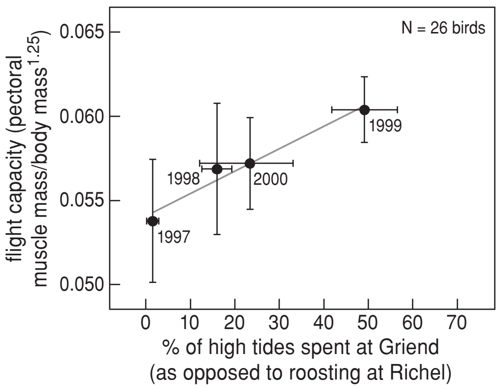

Figure I.3 Flight capacity (pectoral muscle mass/body mass$^{1.25}$ – for further explanation see Chapter 7) as a function of the percentage of high tides spent on the more dangerous roost of Griend compared to the safer roost of Richel.

In fact, a few months later Jan van Gils made a calculation on a small dataset, which suggested that Red Knots trade-off energy costs against safety in choosing roost site. It involved a comparison between birds choosing either Richel or Griend as a roosting site. Richel is a bare sandspit that due, to the absence of landscape structures that could conceal raptor attacks, was considered to be much safer than Griend that is largely bordered by a dyke. As Griend is closer to the principal feeding grounds it was hypothesized that birds would trade-off a roost entailing low energetic and time costs of travel but relatively dangerous (Griend), against a roost with relatively high energetic and time costs of travel but low predation danger (Richel), while this trade-off should depend on the potential for successful escape on attack being determined by the ratio of pectoral muscle to body mass (Dietz *et al.*, 2007). Indeed, Van Gils found that Red Knots that spent more time at the risky roosting site maintained a relatively larger pectoral muscle (Figure I.3), thus appeared to be better suited for escape.

Recapitulating, imperfections in research designs, and limited opportunities for systematic measurements of raptor-shorebirds interactions in the Wadden Sea compared to Banc d'Arguin, explain why the latter area became the core field site for the predation studies in this thesis.