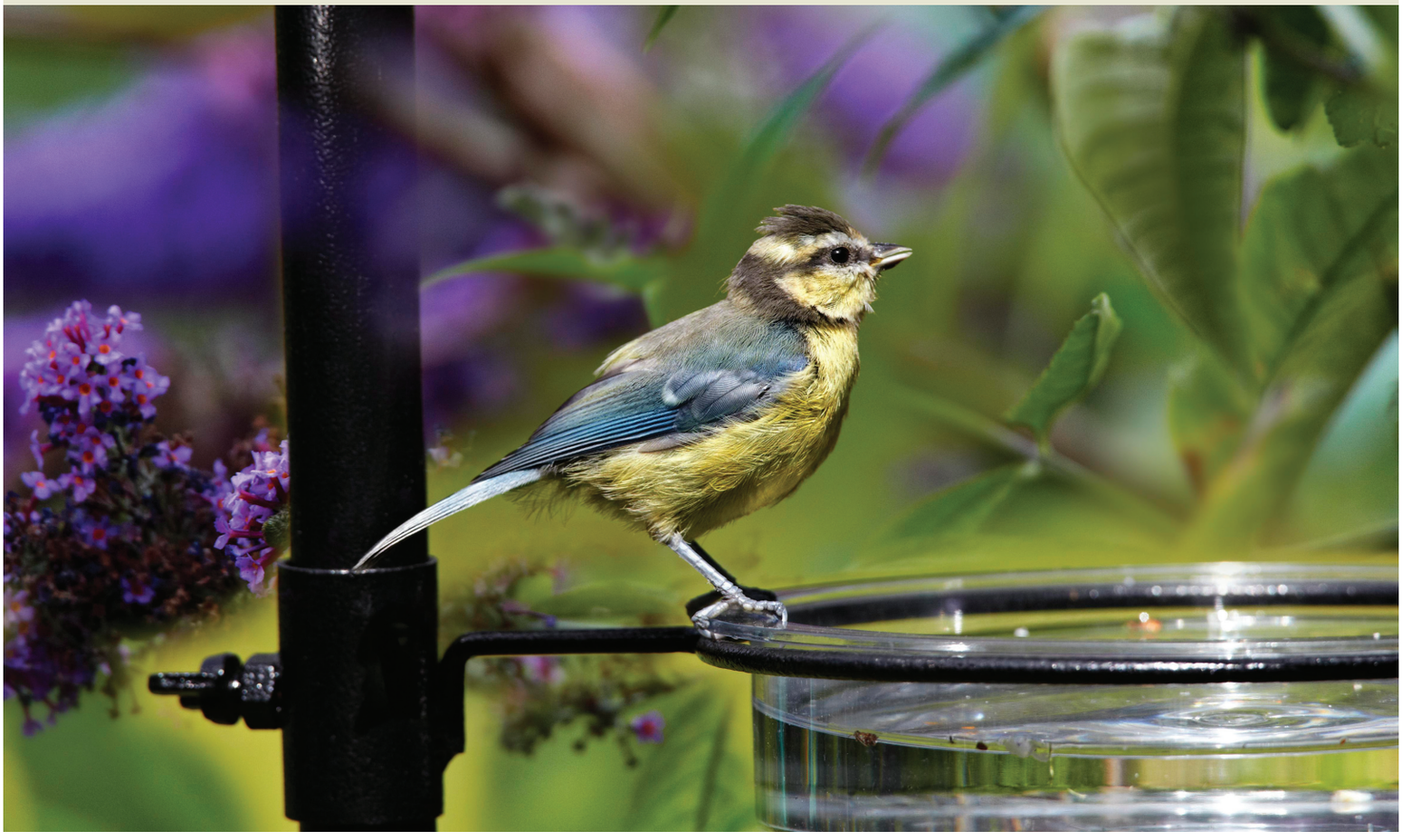
PREMIUM
NATURE'S FEAST
WILD BIRD CARE

# Optimal Foraging Study

## White Paper



TESTED BY BIRDS AND SELECTED

THE **ONLY** BIRD FOOD DESIGNED BY BIRDS



## Executive summary

Nature's Feast has undertaken a comprehensive study of the foraging habits of wild birds. The purpose of the study was to test the hypothesis that there is a significant difference in the food preferences of farmland granivorous passerines. Feeding stations were set up on ten farms, each station consisting of ten feeders filled with ten different seed types selected for the experiment. Observations were then conducted over the course of a four-month period, and the number and species of birds visiting the various feeders recorded on specially designed forms. In total ten bird species made 597 visits to the feeders. Analysis of their visits to each seed type demonstrated that most species showed strong preferences for particular seeds – proving the existence of Optimal Foraging and helping Nature's Feast design tailored seed mixes to attract particular species.

October 2011

## Background

Farmland birds in the UK have suffered massive declines in recent decades because of changes in the agricultural ecosystem.[1] Winter is regarded as having the greatest impact on granivorous passerine survival, due to the availability of seed food.[2] Tree Sparrows, for example, suffered a 94% decline between 1970 and 2001 – one of the greatest population downfalls within the farmland bird community.[3]

Supplementary feeding has been widely used in gardens for many years and has grown into a popular pastime for thousands of people. Surveys using garden bird feeding data have proved invaluable in assessing long-term trends of the more common species such as Greenfinch, Goldfinch and Chaffinch. There have been indications that trends in garden bird populations can reflect those of species in the wider countryside, including farmland.[4] For farmland granivores in particular, it has been suggested that the use of garden feeders increases as food supplies in the countryside decrease.[5] The success of past experiments suggests that supplementary feeding has some value for the conservation of farmland birds.

In fact gardens are thought to hold high proportions of the national breeding populations of many common species and can provide an important source of supplementary food both in the winter[6] and summer.[7] The Garden Bird Feeding Survey (GBFS) and the Garden BirdWatch (GBW) are national surveys designed to indicate trends in garden bird populations and in food provision and usage.

## Research to date

Food preference of birds has been widely investigated, with previous studies looking into the reasons for selection in terms of bird morphology and nutritive value of foods. One such study is that of Diaz (1990), who investigated the preference of ten granivorous passerine species in captivity, when offered thirteen types of seed food, specifically looking at bird morphology, seed size and nutritional composition. However, studies of captive birds have limited relevance to the study of wild birds because the natural environment cannot be accurately replicated in captivity.

It was found that generally the smaller the bird and the smaller its bill the smaller and more nutritive seeds were selected – so for example Finches selected larger seeds than Sparrows and Buntings. It is suggested that this relationship is due to smaller birds having greater energy requirements. As smaller species cannot handle larger seeds, their only way of increasing energy intake is to select more nutritive seeds. Dependence on energy value of seeds decreases as size of bird increases, as larger birds are able to handle larger seeds.

There was, however, a statistically significant relationship between seed size selection and bill size within families (that is Finches, Sparrows and Buntings). It is suggested that this is due to the different 'de-husking' techniques of the three families. Sparrows and Buntings 'de-husk' seeds transversely to the bill axis, making bill width the determining factor and so limiting the size of seed such species can handle. Finches, however, 'de-husk' longitudinally to the bill axis, splitting seeds longer than the bill length as long as there is a line of weakness along the seed. This means seed hardness is the limiting factor in this case, enabling birds to handle larger seeds.[8]



## The Optimal Foraging Study

Optimal Foraging assumes that foraging behaviour is favoured by natural selection and enhances the bird's fitness – that high fitness is achieved by a high-energy intake and that foraging behaviour is witnessed in a natural environment.[9] Birds exploit a smaller range of food items than is available to them in order to maximise their overall energy intake, while balancing factors such as predation risk and the importance of dietary needs other than energy.

If a bird finds a plentiful food source (as at a feeding station), it is able to pass by less desirable foods and forage for the more desirable. The reverse is true for species that do not find a food resource often – for example, birds of prey. This enables the bird to maximise its energy intake and minimise the handling time taken for each food item.[10]

## The aim of the study

The aim of the Nature's Feast study was to determine the seed preference of farmland granivores using supplementary feeding stations in winter, and to test the following hypothesis: "there is a significant difference in food preference of farmland granivorous passerines using feeding stations". The data collected is being used to develop new birdseed mixes that target particular species.

## Methodology

Ten farms located throughout East Yorkshire were selected to take part in the study. Feeding stations were set up on each of the farms in mid November 2005, with each feeding station containing ten feeders filled with the following different seed types:

1. Quinoa *(Chenopodium quinoa)*
2. Black sunflower *(Helianthus annuus)*
3. Wheat *(Triticum sp.)*
4. Linseed *(Linum usitatisimum)*
5. Hemp *(Cannabis sativa)*
6. Canary seed *(Phalaris canariensis)*
7. White millet *(Panicum miliacium)*
8. Red dari *(Sorghum sp.)*
9. Naked oats *(Avena sativa)*
10. Triticale *(Triticum x secale)*

These seed types were chosen for various reasons, but the common reason shared by all (with the exception of black sunflower, which was used as a control), is their lack of use in current commercial birdseed mixes sold for use in feeders, and the common use of these seed types grown as arable crops in the UK.

The location of the feeding station on each farm was chosen carefully. All were set up either on hedgerows of at least 2 metres in height or on tree lines. Feeders were placed as linearly as possible for ease of observation. After initial set up, the feeding stations were left for a one-week 'settling-in' period. Research shows that small birds can usually find supplementary food within one week or occasionally within 24 hours.[11]

Observations were then conducted at fortnightly intervals for a one-hour period during winter. Feeders were filled on a fortnightly basis before each observation, and then observed from a clear vantage point 30-40m from the station.

## The results

In total, ten bird species made 597 visits to the feeders. As the chart below shows, the species that used the feeding stations most frequently were the Greenfinch and the Tree Sparrow, while the species that were recorded least frequently were the Long-tailed Tit and the Brambling.

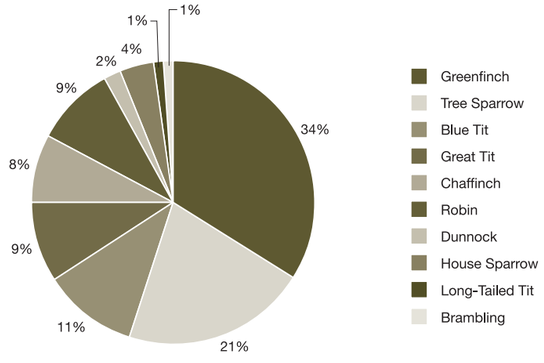



**Figure 1** – Percentage of the total number of visits to stations by each species.

The graphs below show the number of visits each of these species made to the ten different seed types.

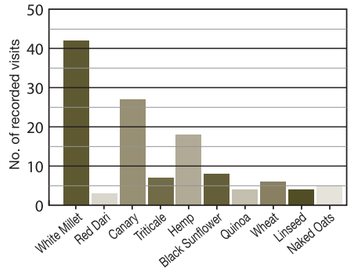



**Figure 2** – The number of recorded visits to each seed type by Tree Sparrow.

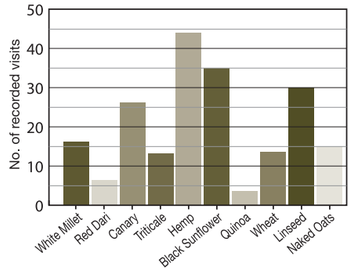



**Figure 3** – The number of recorded visits to each seed type by Greenfinch.

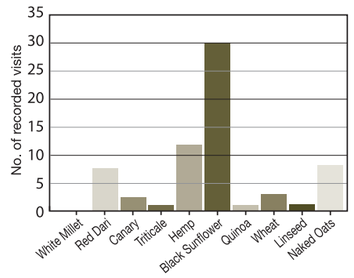



**Figure 4** – The number of recorded visits to each seed type by Blue Tit.

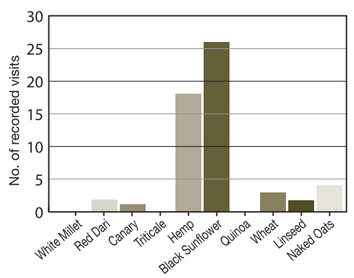



**Figure 5** – The number of recorded visits to each seed type by Great Tit.



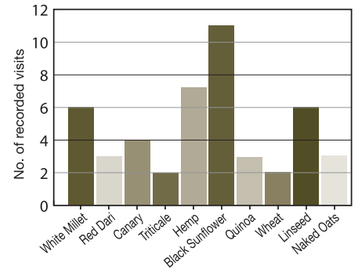



**Figure 6** – The number of recorded visits to each seed type by Chaffinch.

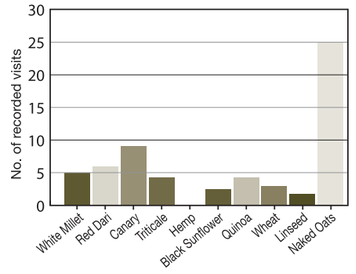



**Figure 7** – The number of recorded visits to each seed type by Robin.

As the graphs demonstrate, all species apart from the Chaffinch showed significant preferences for certain seeds. No species showed total usage of a single food, but in certain cases some seed types were totally avoided.

## Species profiles

The data collected for Greenfinches, Tree Sparrows, Blue Tits, Great Tits, Chaffinches and Robins was sufficient for Jacobs (1974) Preference Index tests to be applied to highlight the strength of preference for each seed type. The Jacobs Preference Index provides a useful guide for preparing a seed mix aimed at target species.

### Tree Sparrow

The index suggests that white millet is the most preferred food of the Tree Sparrow, followed by canary seed. This means that Tree Sparrows show a preference for two of the smallest and least nutritious seeds available. Diaz (1990) suggested that smaller birds select small but more nutritive seeds, so the results here are in partial agreement: Tree Sparrows did indeed select the smaller seeds, but they did not select the seeds with the highest energy content (in fact millet has the lowest of the seeds used in this study).

Sparrows extract seeds from husks transversely to the bill axis, as seen in **Figure 8**. This limits the size of seed the bird can handle.[12] Therefore Tree Sparrows, being small-billed birds, are limited to the smaller seeds available because they're unable to handle anything larger.

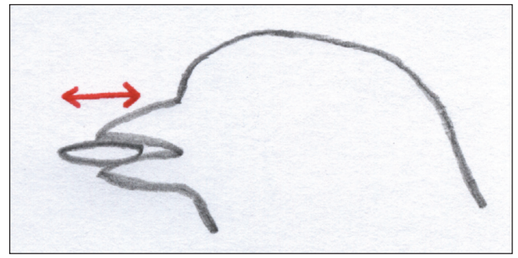


**Figure 8** – Seed extraction by Sparrows and Buntings, with seed length (denoted by red arrow) transverse to bill axis. (Jennifer Wallace, 2006)

Optimal Foraging states that a bird will forage in a way that maximises its energy intake, while balancing the predator avoidance, energy expended and dietary needs other than energy.[13] It may therefore be beneficial for smaller billed species such as Tree Sparrows to sacrifice high energy content for ease and speed of handling. Tree Sparrows have been observed swallowing white millet whole in particularly cold weather,[14] meaning the need for de-husking is avoided. Maximised energy intake is achieved by consuming many smaller, less nutritious seeds than few larger, difficult to handle seeds with a higher energy value. Alternatively, it could be that Tree Sparrows select the largest seed they can cope with regardless of energy content.

### Greenfinches

Greenfinches are larger birds than Tree Sparrows. The results show a preference for hemp followed by black sunflower, two of the largest and most nutritive seeds. Finches de-husk longitudinally to the bill axis, as seen in **Figure 9**, meaning they are able to feed on seeds longer than their bill length as long as there is a line of weakness where the seed can be split. Greenfinches will therefore maximise their energy intake by feeding on the largest and most nutritive seeds as they are able to handle them with speed and ease.

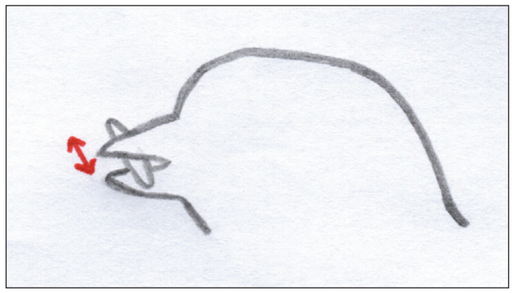


**Figure 9** – Seed extraction by Finches, with seed length (denoted by red arrow) longitudinal to bill axis. (Jennifer Wallace, 2006)

### Chaffinches

Chaffinches did not show any strong preference for any seed type. The least favoured were cereals (triticale and wheat), with a slight preference for black sunflower. It has been suggested that cereals are the main winter food of Chaffinches.[15] However the results here are not in agreement. This is likely to be due to the great abundance of cereal seeds in the countryside: large numbers are available so they're likely to become the favoured food of foraging birds. But at a feeding station, where all seed types are equally available, birds will select their favoured seed. Chaffinches are a fairly large-billed bird explaining their ability to handle large seeds such as black sunflower.



### Blue Tits and Great Tits

The index shows similar preferences for Blue Tits and Great Tits. Both have a strong preference for black sunflower, which is large and high in energy. White millet was totally avoided by the Blue Tit, and the Great Tit totally avoided white millet, triticale and quinoa.

Tit species use a different method of foraging to Finches and Sparrows in that they will not stay on the feeders for any length of time. When foraging they have been observed taking an individual seed out of a feeder then flying into nearby cover to feed. This is a much more energy consuming method of feeding, but when Optimal Foraging is applied it suggests that this may be a predator avoidance mechanism and favouring the high-energy seeds compensates for the energy used in foraging.

### Robins

Finally, the index for Robins indicates a strong preference for naked oats, followed by a weaker preference for canary seed. Both are long, thin seeds but are not the highest in energy. A total avoidance was shown for hemp, with black sunflower and linseed also seeming unpopular. The preference for long, thin, soft seeds is not surprising as the species is not generally granivorous. Robins have long, thin bills adapted for feeding primarily on insects and other invertebrates and do not have adequate strength to de-husk many of the seeds used here. Naked oats do not have a husk and are very soft allowing ease of handling. The hardest husked seeds were avoided, as Robins simply cannot process them.

## Conclusion

Past supplementary feeding experiments have shown potential success in aiding winter survival of many granivorous passerine species. The results presented here suggest that supplementary feeding stations are well used by wild birds as they provide easier, less energy consuming foraging. They also correlate with past food choice investigations in suggesting that species do indeed prefer different seed types depending on seed size, shape and bill morphology, proving the original hypothesis. Such information is vital when designing tailored seed mixes targeted at certain bird species.

## About Nature's Feast

Nature's Feast is the UK's leading manufacturer of food and accessories for the wild bird and small animal markets. Nature's Feast products, which are developed at a hi-tech manufacturing facility in East Yorkshire, have won numerous industry awards. The brand launches new products on a regular basis and improves its existing range based on scientific research and testing. The results of the Optimum Foraging Study – the only study of its kind to have been undertaken by a birdseed manufacturer – has driven modifications and refinements to the recipes of Nature's Feast's popular birdseed blends.

## References


1. Population declines suffered by non-farmland bird species have not been as dramatic as those seen in farmland birds, suggesting that it is changes in the agricultural ecosystem that have driven the declines. (Donald and Gregory, 2002).
2. Fuller et al, 1995. Evans, 1997. Cited in Stoate et al, 2003.
3. Tree Sparrows are Red listed and have suffered a 94% decline between 1970 and 2001, one of the greatest population downfalls within the farmland bird community (Gregory et al, 2004. Perkins et al, 2002).
4. Wells et al, 1998. Cited in Chamberlain et al, 2005.
5. Chamberlain et al, 2005.

6-7. Gardens are thought to hold high proportions of the national breeding populations of many common species and can provide an important source of supplementary food both in the winter (Chamberlain et al, 2005) and summer (Cowie et al, 1988).

8. Food preference of birds has been widely investigated, looking into the reasons for selection in terms of bird morphology and nutritive value of foods. One such study is that of Diaz (1990), who investigates the preference of ten granivorous passerine species in captivity, when offered thirteen types of seed food, specifically looking at bird morphology, with seed size and nutritional composition.






It was found that generally the smaller the bird and the smaller its bill the smaller and more nutritive seeds were selected, therefore mostly Finches selected larger seeds than Sparrows and Buntings. This, however, was not always statistically significant. It is suggested that this relationship is due to smaller birds having greater energy requirements. As smaller species cannot handle larger seeds, their only way of increasing energy intake is to select more nutritive seeds. Dependence on energy value of seeds decreases as size of bird increases, as larger birds are able to handle larger seeds.

There was however, a statistically significant relationship between seed size selection and bill size within families (that is Finches, Sparrows and Buntings).

It is suggested that this is due to the different 'de-husking' techniques of the three families. Sparrows and Buntings 'de-husk' seeds transversely to the bill axis, making bill width the determining factor and so limiting the size of seed such species can handle. Finches, however, 'de-husk' longitudinally to the bill axis, splitting seeds longer than the bill length as long as there is a line of weakness along the seed. This means seed hardness is the limiting factor in this case, enabling birds to handle larger seeds (Diaz, 1990).


9. Optimal Foraging Study may be considered when looking at seed preference of wild birds. It assumes that foraging behaviour is favoured by natural selection and enhances the organism's fitness, that high fitness is achieved by a high energy intake and that foraging behaviour is witnessed in a natural environment (Begon et al, 2006).
10. The reverse is true for species that do not find a food resource often, e.g. raptors. This enables the organism to maximise its energy intake and minimise the handling time taken for each food item (Ricklefs, 1990).
11. After initial set up, the feeding stations were left for a one week 'settling-in' period. This was to allow the birds time to find the new food sources, to get used to their presence and to start using them. Small birds can usually find supplementary food within one week or occasionally within twenty four hours (Rogers and Heath-Cross, 2003).
12. Diaz, 1990 has suggested that smaller birds select smaller and more nutritive seeds. The results here are partially in agreement with those of the literature as Tree Sparrows, being smaller than Greenfinches and Chaffinches have shown a preference for smaller seeds. Sparrows, unlike Finches, extract seeds from husks transversely to the bill axis.
13. Optimal Foraging Study states that an organism will forage in a way that maximises its energy intake, whilst balancing the costs of predator avoidance, energy expended and obtaining dietary needs other than just energy (Begon et al, 2006).
14. Noskov, 1981. Cited in Summers-Smith, 1995.
15. Newton, 1967.

Nature's Feast
Cranswick Pet Products
Pexton Road
Kelleythorpe Industrial Estate
Driffield
East Yorkshire
YO25 9DJ

Freephone: **08000 939 123**
Email: **customer.care@naturesfeast.co.uk**

**www.naturesfeast.co.uk**

13522/1011