

Great Tits exploit aphid galls as a source of food

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We document here how a pair of Great Tits *Parus major* discovered, and used efficiently, a natural source of food which is not tapped by any other bird: the aphids inside the green, inconspicuous galls of *Paracletus cimiciformis* Heyden (Fordinae, Aphididae, Homoptera) on *Pistacia palaestina* (Anacardiaceae). Later in the season the same birds used the galls of the more conspicuous aphid, *Forda formicaria* Heyden, in a similar manner.

Paracletus cimiciformis forms flat, green galls on leaflets of *Pistacia palaestina*, a common tree in the Mediterranean forests of Israel (Koach and Wool 1977). The galls are not uncommon, but are quite inconspicuous to the untrained eye. The gall is initiated in the spring by a single aphid, which reproduces parthenogenetically (review in Wool 1984). At the time of the present observations (September) the clones inside the galls were at peak size (20–50 aphids per gall; Wertheim 1950).

During a routine survey of marked galled *P. palaestina* trees on Mount Carmel, Israel, on 27 September 1990, we noticed a large number of green, fresh leaflets under one of the trees. Eighty-seven leaflets were collected. Upon close examination, nearly all (83) carried galls of *P. cimiciformis*, one gall per leaflet. Seventy-five of the galls (90%) bore clear puncture marks. Some were emptied of aphids. In some, the predator had not been completely successful and live aphids remained inside. Only eight fallen galls were intact.

The identity and behaviour of the predator were observed directly by one of us (M.B.) on 1 October, 1990. Observations were made from a car parked 10 m from the tree, using binoculars. The field record is as follows:

“A pair of Great Tits was seen flying from tree to tree in the neighbourhood. At 17.00 hours, one of them landed on the tree and was immediately joined by its partner. The bird moved on the branches, located a leaflet with a gall of *P. cimiciformis*, held it in its beak and removed it from the leaf. It moved to a larger branch, held the leaf down with its foot, and with quick and well-directed strokes of the beak, opened it and ate the contents. The handling of one gall took less than 30 s. Both partners pursued this activity for 12 min and handled six galls during this time period. When a bird finished handling a gall, the leaflet fell to the ground” (Fig. 1).

We visited the same tree three more times (5 and 23 October, 5 November), and collected a total of 182 leaflets carrying *Paracletus* galls under the tree. Of these, 143 (79%) had been preyed upon by the tits. In addition, in late October, the birds started using the galls of the more common gall-forming aphid *Forda formicaria* Heyden, which were absent in the first two samples. This species seems to be used less by the birds (244 galls collected: 139 (57%) consumed).

A few consumed *Paracletus* galls were found under two more trees nearby (presumably in the foraging territory of the same pair of birds). On 5 November, we found evidence of tit predation on *Paracletus* under another tree 500 m away (32 of the 41 galls consumed).

In his monograph on British tits, Perrins (1979) describes these birds as follows (p.131): “Tits are perpetually inquisitive and frequently investigate strange objects. Presumably in this way they find new sources of food....They also show considerable ingenuity when it comes to reaching food in difficult sites”. Among the feats accomplished by these birds, the most frequently

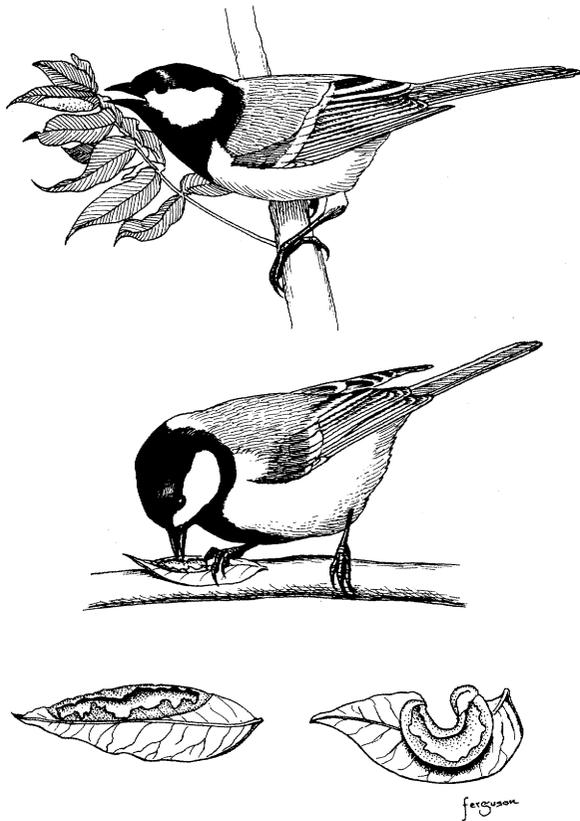


Fig. 1. Great Tit handling an aphid gall. Top: approach to a leaf with a gall. Middle: pecking at a gall. Bottom: Consumed *Paracletus* (left) and *Forda formicaria* (right) galls.

cited is learning to open milk bottles to drink the cream (Fisher and Hinde 1949).

Few cases of bird predation on aphid galls have been published. Sunose (1980) describes predation by Tree Sparrows *Passer montanus* on aphid galls (*Tetraneura* sp., *Colopha moriokaensis*) in Japan. Wool (1984) mentions that in the desert highlands of Israel, many galls of the aphid *Geoica utricularia* (Pass.) are broken open and emptied, presumably by birds (direct observations on predation are not available in this case). Bulbuls *Pycnonotus barbatus* were recently observed pecking at the large, red, "cauliflower" galls of *Slavum wertheimae* HRL on *Pistacia atlantica*, and feeding on the aphids (N. Barel, pers. comm.).

Sunose (1980) suggests that the birds may have mistaken the gall for fruit, and when puncturing it, by chance discovered that it contained aphids. This sequence of events is unlikely to have happened in the case of the tits. *Paracletus* galls do not resemble anything edible. Moreover, the gall tissue is rich in distasteful compounds (e.g. tannins), and birds that happen to peck at a gall are likely to be repelled unless they discover a reward inside. We believe that the recognition of the gall as a food source was initially a matter

of chance. The inquisitive birds may have inserted their beaks through the crevice on the upper surface of the gall, or perhaps noticed some aphids come out. The habit of picking up objects (such as seeds) to a perch and holding them with their feet while pecking at them is common and well known in tits (Perrins 1979). But removing a fresh leaflet with the gall from the leaf seems to be a novel invention. Owen (1975) reported on Blue Tits *Parus caeruleus* preying on leaf miners *Phyto-myza ilicis* on holly *Ilex aquifolium*. The birds punctured the leaves in situ to get the larvae. This technique would not work in the long, flexible leaves of *P. palaestina* (Fig. 1, top). Interestingly, the birds seem not to have discovered the fact that the upper side of the gall may be pulled up to reveal the aphids. Rather, they peck at the gall from both sides in equal frequency (of 163 galls, 77 were opened from above, 86 from below; $\chi^2 = 0.506$, 1 df, n.s.).

The birds' switching to *Forda formicaria* at the end of the season is very interesting; perhaps when *Paracletus* galls became scarce, the birds searched for alternatives (*F. formicaria* and *Paracletus* galls may occur on the same leaves). In mid October the *F. formicaria* galls were beginning to open to release the aphids, and perhaps this made it easier for the inquisitive tits to learn to associate the conspicuous galls of this species with the presence of food. A *F. formicaria* gall may contain 100–150 aphids, quite a rich source of insects for the birds.

We do not know if the pair of birds we observed is the only pair which has mastered the technique of exploiting this food source. D.W. has been studying aphid galls on *Pistacia* since 1972 and never observed birds preying on them in this way. During the summer of 1990 we closely observed 16 marked trees on the Carmel and did not find any evidence of galls being exploited by birds, except in the neighbourhood of this one tree. However, the sample taken on 5 November, collected 500 m away, may indicate that more than one pair were using galls for food.

The chance of this behaviour spreading to other birds, like the opening of milk bottles in England, depends on either the young birds following their parents after fledging and imitating them, or on birds imitating their neighbours. However, the first option is not likely because until July or even August, only one or very few aphids exist in the galls, and thus there may be no reward for opening a gall. In September and later months, the birds do not breed. The second option is also limited since tits are territorial in Israel throughout the spring, summer and autumn (Yavin 1987), and therefore neighbours are not likely to have seen them perform this behaviour. It would thus seem that the rate of "cultural transmission" of the technique of using aphid galls for food should be rather slow.

However, Sherry and Galef (1984, 1990) suggest that observation and imitation may not always be necessary for birds to learn a new technique. In their experiments

with caged Black-capped Chickadees *Parus atricapillus*, the birds learned to open cream tubs when presented with pre-opened tubs containing food. Four of 16 birds opened the tubs spontaneously on the first trial. We cannot rule out the possibility that the discovery that galls contain food was made independently by more than one pair of tits and that the technique of handling them is more widespread than we realise.

Almost exactly on the same date as last year (23 Sept. 1991), just as the final editorial changes were being introduced into the manuscript, the first five galls with clear tit predation marks were found – under the same tree. It is likely that one or both of the original tits survived the year and bred in the same territory.

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IOC Working Groups in Applied Ornithology

The International Ornithological Congress set up the Standing Committee on Applied Ornithology at the Ottawa Congress in 1986. The Committee was allowed to settle its own terms of reference, and it concentrated at first on making recommendations for symposia topics concerned with applied ornithology for the IOC in New Zealand. “Applied ornithology” is understood as meaning a practical study of areas where birds cause problems to human interests; bird conservation, which is also applied ornithology, is being left to other bodies. The Committee was re-appointed in 1990 and has decided to concentrate on two tasks: to advise the IOC on topics, and to improve communication between applied scientists and pure scientists in areas of applied ornithology. The Committee now has four Working Groups, with the following chairmen:

Bird hazards to aircraft: *Mr Luit Buurma, Luchtmachtstaf ALBV, Postbus 20 703, 2500 ES 's Gravenhage, the Netherlands.*

Bird damage to agriculture: *Dr Richard Dolbeer, USDA/APHIS/ADC, Denver Wildlife Research Centre, 6100 Columbus Avenue, Sandusky, Ohio 44870, USA.*

Birds as indicators of environmental change: *Dr Bob Furness, Applied Ornithology Unit, University of Glasgow, G12 8QQ, U.K.*

Diseases transmitted by birds to people and livestock: *Dr John Cooper, Faculty of Veterinary Medicine, Sokoine University of Agriculture, P.O. Box 1387, Morogoro, Tanzania.*

We would wish each welcome, in the fields for which we are respectively responsible, to supply information on current and recent work, especially written but unpublished papers and current research projects. We would include information of this kind in reports which we will write on these four areas. These reports will be presented at the 1994 IOC and published in the 1994 IOC Proceedings. Meanwhile we will provide at least one interim report, summarizing all the information we receive, and distribute it to everyone contributing information used in it, and to the members of the Standing Committee. We stress that we are not interested only in your own research, but in all research which you can tell us about, in any of the above areas. Our aim is to make more widely available, to people working in these fields, much of the useful unpublished information which does not appear in conventional ornithological journals.

On behalf of the IOC Working Group chairman.

R. W. Furness