Helminth-eating in grebes

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That grebes (Podicepedidae) eat their own feathers and give them to the young is well known, but their equally strange and intriguing habit of eating their own helminths (intestinal worms) and giving these to the young seems not to have been previously recorded. To date, I have observed helminth-eating only in the Great Crested Grebe *Podiceps cristatus* (the main subject of the present paper) and the Red-necked Grebe *P. grisegena* (one record).

Observations on Great Crested Grebes

I obtained ten records of helminth-eating and associated behaviour at Old Theale Gravel-pit, Berkshire, in 1957 and two more at New Theale Gravel-pit in 1961 (see Table 1), those at Old Theale during a special watch on five pairs (A–E), three of which (A, B, and D) had young. Later, 16 further observations were made at Chew Valley Lake, Avon (see Table 2), mainly in 1968–1969 during watches on two families: the one occupying the inner part of Herons Green Bay on the main lake (the 'Arm' family), the other living on Herriotts Pool, the separate catchment area (the 'Pool' family). For further information on all these families, see Simmons (1970b, 1974).

The records in Tables 1 and 2 are supplemented below by additional details which clearly establish that some Great Crested Grebes (at least) will deliberately seek and eat helminths.

Obtaining the helminth

In both Berkshire and Avon, Great Crested Grebes 'caught' their own helminths (1) directly, by extracting them from the cloaca (HC in Tables 1 and 2), and (2) indirectly, by picking them up in the water (HW), at least at times immediately after defaecating (Df). On

Table 1. Records of helminth-eating and associated behaviour in Great Crested Grebes at two Berkshire gravel-pits.

Record	Date	Identity of grebe	Sequence
1. Old Theale Gravel Pit, 1957			
1	22 June	♂ A	CT + PT
2	8 July	♂ A	CT + PT
3	3 August	♂ A	CT → Dv
4	17 August	♂ B	Dv → HW → BH → RH → EtH + ChH
5	19 August	D-chick CT	
6	25 August	♂ D	SSf → HW → BH → EtH + ChH
7	28 August	♂ C	Dv → HW → MtH
8	7 September	♂ D	PT → HC → EtH
9	5 October	♂ A	Df → SDf
10	12 October	♂ B	CT → Dv
2. New Theale Gravel Pit, 1961			
11	5 March	?	CT + PT → EtM
12	15 March	♂	CT + PT → HC → BH → EtH

Key. CT = chases tail. PT = pokes under tail. Dv = dives. SSf = searches from surface. Df = defaecates. EDf = examines defaecation. SDf = searches defaecation. HC = extracts helminth from cloaca. HW = obtains helminth from water. PlH = 'plays' with helminth. BH = breaks up helminth. RH = retrieves helminth. EtH = eats helminth. EtM = eats 'something'. ChH = gives helminth to chick. MtH = gives helminth to mate. See text for further details.

Table 2. Records of helminth-eating and associated behaviour in Great Crested Grebes at Chew Valley Lake, Avon.

Record	Date	Identity of grebe	Sequence
1. Herriotts Pool, 1967			
13	2 November	Pool	Df – EDf
2. Main lake, 1968			
14	11 January	?	? → PlH → RH → EtH
15	26 August	Arm ♂	Df → EDf → Dv
16	3 September	Arm ♂	SSf → HW → ChH
17	9 September	Arm ♂	SSf → HW → ChH → SSf → HW → EtH → Dv
18	13 September	Arm ♂	Df → SDf
19	25 September	Arm ♂	Df → SDf → HW → BH → EtH + ChH
20	26 September	Arm ♀	Df → SDf → HW → BH → EtH + ChH → Dv
21	27 September	Arm ♂	Dv → HW → EtH
22	2 October	Arm ♂	? → EtH
23	14 October	Arm-chick 2	? → EtH
24	18 November	Arm-chick 1	PT → HC → EtH
25	20 November	Arm ♂	PT → HC → EtH
3. Herriotts Pool, 1969			
26	10 July	Pool-chick 1	PT → HC → PlH → RH → ?
27	17 July	Pool-chick	? → EtH
4. Main lake, 1974			
28	12 April	Arm	Dv → HW → PlH → RH → EtH

For key to abbreviations, see Table 1. All records from the main part of the lake refer to Herons Green Bay except record 14 (Hollow Brook area).

eight occasions, a bird was seen to turn its head round, stretch the neck back, and then preen and probe energetically in the area of the vent (PT—records 1–2, 8, 11–12, 24–26). At the Theale gravel-pits, but not certainly at Chew, birds sometimes 'chased the tail' like a dog (CT) as they probed, i.e. spinning quickly round several times in a tight circle on the water, though this behaviour also occurred without any apparent preening but with the bill poised ready (records 3, 5, 10). Tail-chasing and probing were sometimes followed by the swallowing of unidentified material (EtM—records 11, 24) or sometimes by the definite extraction of a helminth, or part of one, from the cloaca (HC—records 8, 12, 25–26). Twice (records 3, 10) the birds dived (Dv) after pecking under the tail, apparently in search of something in the water. On four other occasions (records 4, 7, 21, 28), however, they dived first without preening and then surfaced with lengths of helminths in the bill (HW); this material, presumably, had also come from the individual's own cloaca, though possibly it was found floating freely in the water after leaving another grebe. The same alternatives applied also in cases when helminths were obtained, without any obvious preliminaries, by searching from the surface by 'peering' with the head submerged to just above the eyes (SSf—records 16–17). Two records (19–20), however, clearly indicate that helminths were voided in the bird's own excrement at times, signs of the latter usually being quite obvious as a sudden white patch or 'trail' on or near the surface of the water behind the swimming grebe. On six occasions (records 9, 13, 15, 18–20), the bird either examined the defaecation (EDf) from above the water with bill poised (13, 15) or actively searched in it with head submerged (SDf—9, 18–20), once (record 15) then diving into the trail. Sometimes, as shown by records 19–20, it was indeed then successful in obtaining a helminth. Although in the case of records 4, 6–7, 16–17, 21, and 28 (discussed earlier) the

grebe was not actually seen to defaecate, it remains a strong possibility that at least some of the helminths secured then by diving or surface-hunting had in fact been first voided in the bird's own excrement.

Great Crested Grebes also receive helminths from their mates, at least occasionally (record 7), and, in the case of the young, from their parents (records 4, 6, 16–17, 19–20). It seems highly probable, too, that both adults and chicks sometimes "steal" helminths from the defaecations of other members in the family group. Both chicks and, to a lesser extent, adult females evinced interest on seeing the parent or mate with a helminth, usually approaching closely and then sometimes diving or surface-hunting nearby, often amongst the debris of the defaecation. The young also begged intensely. I have only the one definite record of a male passing the helminth to his mate; as this had other unusual features, it is worth giving in more detail. The pair involved, 'C' at Old Theale, had no young. The male surfaced from a dive holding a length of helminth; as he paused on the water, one of the chicks of the neighbouring pair 'D' came right up to him, begging, but the male dived away, joined his mate (who had also approached with interest), and gave her the worm to eat. This was my only record of a helminth instead of a fish featuring in the 'food-presentation' behaviour of a mated pair (see Simmons, in press).

The appearance of the helminth

On 17 occasions, through binoculars or telescope, I obtained views of the helminths as they were held by the grebes: four times at Old Theale (records 4, 6–8), once at New Theale (record 12, see further below), and twelve times at Chew (records 14, 16–17, 19–23, and 25–28). At Old Theale, the helminths were described in my notes as long strings of thin, white stuff like vermicelli; the one estimate of length, originally in inches, was 10–13 cm (record 8). At Chew, both on the main lake and on Herriotts Pool, the descriptions were mostly closely similar to those at Old Theale; one, however, was somewhat more expansive—'a limp, opaque item like wet skin or vermicelli'. Four estimates of length were *c.* 11 cm (record 14), 5–8 cm (record 19), 12 cm (record 26), and *c.* 7 cm (record 28). The one record from New Theale, however, was different from all the others: two lengths of a dark, thread-like material each some 15 cm long.

Eating the helminth

At the Berkshire and Avon waters, the Great Crested Grebes usually paused after securing a helminth before eating it. They either just held it in the bill or (records 4, 6, 12, 19–20) actively broke it up first (BH in the tables), sometimes (records 14, 26, 28) 'playing' with it, i.e. flicking it away (P1H) and retrieving it (RH), sometimes by diving. It was these pieces, particularly, that might be shared with the young or 'stolen' from the water by other members of the family.

Young grebes and their own helminths

Record 26 establishes that young Great Crested Grebes, as well as obtaining helminths to eat directly or indirectly from their parents, will deliberately seek their own. This chick, aged 46 days and still not full-grown, was clearly seen to extract the helminth from its cloaca, tugging it out like a length of elastic; though the young grebe repeatedly flicked the helminth away and retrieved it (sometimes by diving), it did not appear to eat it. The bird in record 24, however, certainly did—though this was by then a fully fledged juvenile aged 95 days. The chick seen chasing its tail (record 5) was of the same age as the first, as was that in record 23 while the one in record 27 (at 52 days) was slightly older. In the last two cases, the birds were already eating the helminths (almost certainly their own) when observed.

A record for the Red-necked Grebe

On 30th September 1969, a transient juvenile at Cheddar Reservoir (Avon), that I had been watching feeding for several hours also on 26th September (see Simmons, 1970a), extracted a helminth from its cloaca during a preening session. As at Old Theale and Chew, the worm resembled a length of vermicelli; the bird 'played' with it, flicking it away and retrieving it, and had twice to crash-dive away from Black-headed Gulls *Larus ridibundus* hovering overhead before eventually swallowing it.

This bird was not seen to chase its tail. However, adult Red-necked Grebes that I watched in Denmark in 1966, unlike Great Crested Grebes, habitually rotated in the water while rolled over on the side and preening the exposed ventral plumage, so care should be taken not to confuse this with helminth-seeking behaviour.

Discussion

Croll (1971) published a note of a Blackbird *Turdus merula* that extracted a tapeworm from its cloaca after defaecation. I understand from Dr. N. A. Croll himself (letter dated 22nd April 1974) that the observations described in the present paper are otherwise unique and that virtually nothing is known by helminthologists about these phenomena.

The records at Old Theale in 1957 were my only ones for this water in some 200 visits totalling about 300 hours during 1948–1962, but visits outside 1957 tended to be short. The records from New Theale were the only ones in 40 short visits during 1955–1962. No records were obtained from other waters in the same study area although I made nearly 500 visits to one of them, Burghfield Gravel-pit, totalling 900 hours; however, the behaviour could well have been overlooked there, especially in the earlier years (most visits being prior to 1957 when the helminth-eating was first recorded at Old Theale) and an entry in my note-book in 1961 remarked generally on the great interest the grebes showed in their defaecations (though whether this applied to birds at all the local waters, or just to those at the Theale pits, is not now clear). The records from Chew were my only ones in some 450 visits over nearly 1700 hours during 1966–1970 (plus one casual observation later). No records were obtained from the adults watched intensively on Herriotts Pool in the three seasons 1967–1969, and only two from the young; many more were forthcoming, however, from the Arm adults and their young on the main lake although these were watched less, mainly in 1968. No sign of helminth-eating behaviour was seen at nearby Blagdon Lake which I visited on 42 occasions during 1966–1970. Although negative records always require particularly careful assessment, it thus seems possible that the habit is more prevalent at some localities than at others.

It would also seem that male Great Crested Grebes are more likely to show helminth-eating behaviour than females: of the 22 records detailed in the tables concerning adults of known sex, 21 were of males (at least six individuals) and only one of a female. Even in the latter case (record 21), it was not certain that the female involved was actually eating her own helminth; she could well have obtained it in one way or the other from the male.

No specimens of the helminths involved were obtained, but it seems highly likely that these were tapeworms (Cestoda) rather than any of the other groups of intestinal endoparasites known from grebes, such as roundworms (Nematoda). The biology of cestodes is complex. Many aquatic forms have pseudophyllidean life cycles. The eggs hatch in the water and the first larval stage (or coracidium) is free-swimming. This is taken by the first intermediate host, a planktonic copepod (e.g. *Cyclops*), within which it develops into the second larval stage (or procercoid). The copepod is, in turn, eaten by the second intermediate host, a fish, within which the cestode now develops into the final larval state (or plerocercoid). It remains a plerocercoid until its host is eventually taken by a suitable, warm-blooded primary host, usually a fish-eating bird, within which (in the much warmer temperature) it develops into the adult stage and the whole process begins anew.

In the case of most tapeworm genera commonly found in grebes and other waterbirds, such as *Schistocephalus,* the adult stage living within the intestine of its host is very different from the plerocercoid, a complex of many segments (proglottids) which bud off from the original organism which had anchored itself to the wall of host's intestine by a special attachment organ (the scolex). The terminal proglottids are self-fertilizing and periodically break off and pass out though the cloaca of the host full of eggs. In the case of the grebes, it seems highly likely that it is one of these that is liable at times to fall prey to its host or other members of the latter's family, and Dr J. J. M. Flegg has suggested to me (verbally, December 1973) that both proglottid and eggs may provide a valuable source of food. This would take the form not only of protein but also of glycogen and fat (see Rothschild & Clay, 1952), provided the grebe could digest them in this particular form. Both the plerocercoid and the adult stage *in situ* within the bird's intestine are, of course, like other helminths, well adapted to life as endoparasites and are resistant to digestive processes. However, this may not apply to the terminal proglottid once it has left the host and been subjected to disintegration by the latter, or another grebe, prior to ingestion and then to passage into and through the stomach.

Ligula intestinalis, another pseudophyllidean tapeworm also found commonly in grebes and other waterbirds, differs from *Schistocephalus* in that it is neotenous (becomes sexually mature in the larval form), the plerocercoid changing but little in size and form after reaching the primary host. Those plerocercoids less than 10 cm long fail to survive ingestion by the grebe (Geiger, 1957) but

others of the maximum length, 12–17 cm, grow only to about 20 cm on becoming adult. When eggs are produced, they are liberated within the host's intestine and pass out with the bird's defaecation into the water without being encased in any terminal segment. With *Ligula,* therefore, it would be the entire helminth that at times falls prey to the grebe 'accidentally' when extracted by the bird or voided in its excrement. *Ligula* usually lives in the last third of the intestine (Geiger, 1957); in some ways it is less well adapted as a helminth than many other tapeworms—for instance, it lacks a proper scolex (the hooked attaching 'head') and is more mobile within the intestine, thus making itself more vulnerable to unintentional expulsion in one form or another, especially when its travels take it to the cloacal region either for feeding (as suggested to me by Dr N. A. Croll) or for egg-laying.

Grebes also act as the final hosts for cyclophyllidean tapeworms (such as *Hymenolepis, Schistotaenia* and *Tatria*) whose cysticeroids live in invertebrates, not fish. The relevant features of the biology of such helminths otherwise resemble those of *Schistocephalus* outlined earlier.

The main prey of the Great Crested Grebes both at the Berkshire gravel-pits and at Chew Valley Lake during my studies was coarse fish, especially Roach *Rutilus rutilus* (Simmons, 1970b). While nothing was known of the cestode infestation of the fish at the Berkshire waters, research on the Roach at Chew in 1965–1968 showed that the population on the main lake was heavily parasitized by plerocercoids of *Ligula* (Wilson, 1971). The Roach on Herriotts Pool, however, were practically free from cestodes; unlike those of the main lake, which fed largely on zooplankton (including infected copepods), those on the catchment pond largely ate adult insects, zooplankton being scarce. At Chew, therefore, it is evident that the grebes living on the main lake were exposed to a much greater risk of parasitism by tapeworms than those on Herriotts Pool. This is reflected in the records of helminth-eating at the two localities, and such factors may well explain the uneven distribution of records here and at other waters (see above). The apparent difference between male and female Great Crested Grebe in helminth-eating behaviour—which could be taken to indicate that females are less heavily parasitized by cestodes—remains an unresolved problem requiring further investigation. It is possible that the 'tradition' for helminth-eating is a local phenomenon because the habit is largely acquired by learning, some individuals (especially females for some reason), families, or even whole populations failing to develop it.

If the tapeworm involved in my records was indeed largely *Ligula,* then further intriguing problems emerge. Is *Ligula* digested or can it survive passage into the lake and then run the course of the gut to the intestine? The latter is the critical parasitological question, as pointed out to me by Dr N. A. Croll, for if the ingested *Ligula* can reach the haven of the intestine again alive, either within the original host or its young or mate, then the grebe by its own behaviour has re-infected itself or passed the cestode on to members of its own family group. There is even a possibility, again suggested to me by Dr Croll, that 'the size, movements and colour of the tapeworm would ... mimic those of fish or annelids and would therefore elicit a normal feeding response from the grebe. Although somewhat fanciful, and lacking "hard" scientific support, there are a number of scattered observations which suggest the parasite's behaviour can enhance its transmission through increasing its chances of being eaten'.

The question of the survival value of helminth-eating to the Great Crested Grebe itself remains open. Are tapeworms, in whatever form, a source of food or is the habit of eating them merely a neutral one (in the case of terminal proglottids and eggs which, if not actually digested, would pass harmlessly through the grebe) or potentially harmful (in the case of *Ligula* which, if not digested, would be re-cycled if still alive)? My guess is that the grebes do get nutriment from the ingested tapeworms, in the case of *Ligula,* especially, because they seem usually to break up the helminth before swallowing it. Certainly there can be no doubt that both adults and young show great interest in the tapeworms as potential food and appear to relish them. That tapeworms and their eggs can be important as a source of food is demonstrated by the scavenging feeding habits of the Sheathbill *Chionis alba* which obtains them in considerable numbers from the excrement of penguins (Spheniscidae) and other colonial seabirds (see Rothschild & Clay, 1952).

I know of no further records, published or unpublished, of helminth-eating in the Podicepedidae in spite of the fact that they have been increasingly studied in recent years, especially within the Holarctic. My single observation on the Red-necked Grebe indicates similar behaviour to that found in the Great Crested. The small race of the Red-necked Grebe in the west Palearctic feeds mainly on invertebrates, as also do the Black-

necked Grebe *P. nigricollis,* the nominate race of the Slavonian Grebe *P. auritus* (Fjeldså, 1973), and the Least Grebe *P. dominicus.* Possibly these grebes are less exposed to tapeworm parasitism than the almost wholly fish-eating Great Crested, which might explain the lack of records of helminth-eating. Had the Red-necked Grebe at Cheddar perhaps been eating fish or had it been infected by tapeworms which use invertebrates as intermediate hosts? The large race of the species in North America and eastern Asia *(holbolli)* is, however, essentially piscivorous like the Great Crested Grebe. This is true also of the Western Grebe *Aechmophorus occidentalis* of North America, while the large-billed northern race of the Slavonian Grebe *(arcticus)* is more omnivorous than the nominate and includes many fish in its diet (Fjeldså, 1973), as do the American race *(cornutus)* and the Little Grebe *Tachybaptus ruficollis,* the remaining Holarctic grebe. My guess is that helminth-eating has been overlooked in these other grebes and that records will be forthcoming now that observers have been alerted to the problem.

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Summary

Great Crested Grebes *Podiceps cristatus* eat helminths, almost certainly tapeworms (Cestoda). These are extracted from the bird's own cloaca or obtained from the water after defaecation, or obtained (directly or indirectly) from the parent and, at least occasionally, from the mate. Young grebes also show interest in their own helminths, from at least the age of about 45 days. It is possible that the habit is confined to certain localities, families, or individuals mainly because of differences either in the degree of local tapeworm infestation or in 'traditions' arising out of the learning processes involved in the acquisition of the behaviour. Amongst adults, nearly all the records of helminth-eating and associated behaviour involved males. The types of tapeworm likely to be involved are reviewed and the biological value, or otherwise, of helminth-eating discussed, especially with reference to its possible nutritional value and to the possible harmful effects of recycling intact adult tapeworms. A record of helminth-eating is also given for the Red-necked Grebe *P. grisegena,* and the likelihood of the habit existing in other Podicepedidae discussed.

References

Croll, N. A. 1971. Blackbird extracting tapeworm. *Bird Study* 18: 52–53.
Fjeldså, J. 1973. Distribution and geographical variation of the Horned Grebe *Podiceps auritus* (Linnaeus, 1758). *Orn. Scand.* 4: 55–86.
Geiger, W. 1957. Die Nahrung der Haubentaucher *(Podiceps cristatus)* des Bielersees. *Orn. Beob.* 54: 97–133.
Rothschild, M. & Clay, T. 1952. *Fleas, Flukes and Cuckoos.* London: Collins.
Simmons, K. E. L. 1970a. Duration of dives in the Red-necked Grebe. *Brit. Birds* 63: 300–2.
Simmons, K. E. L. 1970b. The biology of the parent-chick stage in the Great Crested Grebe *Podiceps cristatus.* Ph.D. thesis, University of Bristol.
Simmons, K. E. L. 1974. Adaptations in the reproductive biology of the Great Crested Grebe. *Brit. Birds* 67: 413–37.
Simmons, K. E. L. In press. Further studies on Great Crested Grebes. *Bristol Orn.* 8.
Wilson, R. S. 1971. The decline of a Roach *Rutilus rutilus* (L.) population in Chew Valley Lake. *J. Fish Biol.* 3: 129–37.

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