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The First New Zealand Insects Collected on Cook's *Endeavour* Voyage[1]

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ABSTRACT: The Banks collection of 40 insect species, described by J. C. Fabricius in 1775, is critically examined to explore the possible methods of collection and to document changes to the insect fauna and to the original collection localities since 1769. The assemblage of species is regarded as unusual. It includes insects that are large and colorful as well as those that are small and cryptic; some species that were probably common were overlooked, but others that are today rare were taken. It is concluded that the Cook naturalists caught about 15 species with a butterfly net, but that the majority (all Coleoptera) were discovered in conjunction with other biological specimens, especially plants. Possible reasons for the omission of wetas, stick insects, etc., are discussed. This early collection shows that marked changes in abundance may have occurred in some species since European colonization. One new record is revealed: The cicada *Notopsalta sericea* (Walker) was found to be among the Fabricius specimens from New Zealand, but its description evidently had been overlooked.

THE FIRST COLLECTIONS of animals from New Zealand by naturalists on Cook's *Endeavour* voyage had, in most cases, to survive a varied history before becoming part of the permanent scientific record or of an institutional collection. That the insects, as a group, did somewhat better than most is a fact owed in part to their relatively easy preservation and in part to the industry of the Danish taxonomist J. C. Fabricius, who described them. It might also be said that the insects survived because they were largely inedible and that to some degree they had value as "collectibles," even in the eighteenth century. More detailed historical background is given in Andrews (1986).

The nature of the voyage undertaken by Cook, Banks, Solander, and the others was such that in no way could it be regarded as supporting a systematic attempt at a representative collection of the New Zealand insect fauna. The naturalists on board *Endeavour* were generalists whose task was to collect all sorts of natural history specimens. Joseph Banks himself was primarily interested in the terrestrial flora, and none of them could be described as entomologists. However, they were equipped for catching and preserving insect specimens, and certainly retained some of the specimens they encountered. No comments about the insects were recorded in their diaries, nor were there indications of collection localities attached to the specimens. So, apart from the descriptions of Fabricius and the specimens themselves, we are left with very little documentary evidence of much note. Yet the earliest assemblage of insects from New Zealand is, in fact, full of interest. It includes some unusual and unexpected species, it holds a key to the activities of the first naturalists, and it hints at some important changes that probably have occurred since 1769.

In order to consider these issues, we have examined the list of insects collected and now pose the following questions:

1. Who collected the insects, and what techniques were used for their preservation?
2. How were they collected: deliberately or inadvertently?
3. What, if anything, does the collection tell

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us about changes to the insect fauna that have taken place in the past 200 years?
4. What changes have taken place at the collection localities?
5. Can specific localities be assigned to any of the specimens (type localities)?

There are areas of overlap among these questions, and it was clear from the outset that some of the answers would contain at least a degree of speculation. Nevertheless, it was hoped that the present study would provide some insight into the workings of the early naturalists, as well as useful entomological information.

Previous work relating specifically to insect material from Cook voyages includes Dugdale and Fleming (1969) on the cicadas and Kuschel (1969, 1987) on the Curculionidae. Andrews (1986) provides some historical background to the original collections and their subsequent description. Unpublished material from the Department of Scientific and Industrial Research (DSIR) Entomology Division also was found useful in the present work (Kuschel, personal communication). It has been noted previously (Dugdale and Fleming 1969) that the journals of both Banks and Cook contain very little detailed information on their collecting. Nor does it appear that the Solander manuscripts make any reference to New Zealand insects. The impression received is that Banks thought the New Zealand insect fauna rather sparse ("a few butterflies and beetles"), with some of it reminiscent of the Northern Hemisphere species. So, for our interpretations of the *Endeavour* voyage insect collection, we rely upon the insects themselves, together with other information more specific to the voyage and the personalities on board.

In an attempt to seek some answers to the questions raised above, we undertook separate visits to each of the localities where Cook's naturalists were presumed to have collected. Each visit was timed to coincide as closely as possible (at least within a few days) with the dates of the original expedition (see Figure 1 and caption for dates and locations of landings). D'Urville Island, their last port of call in New Zealand, was excluded, partly for logistic reasons and partly because of the unlikelihood of their having taken anything of significance from this locality (see below). Our collections of insects were made at each locality by using nets, beating trays, and searching driftwood and forest logs. The edited journals of Cook and Banks were examined, as was the Solander manuscript MS.Z4 [(A fair copy of the descriptions of animals observed during Cpt. Cook's first voyage; 512 folio pages) Zoology Library, British Museum (Natural History)]. We were also assisted by photographs of specimens in the British Museum (Natural History), and one of the authors (GWG) had the opportunity to examine some of the New Zealand insects from the Fabricius collection held at the Zoologisk Museum, Copenhagen.

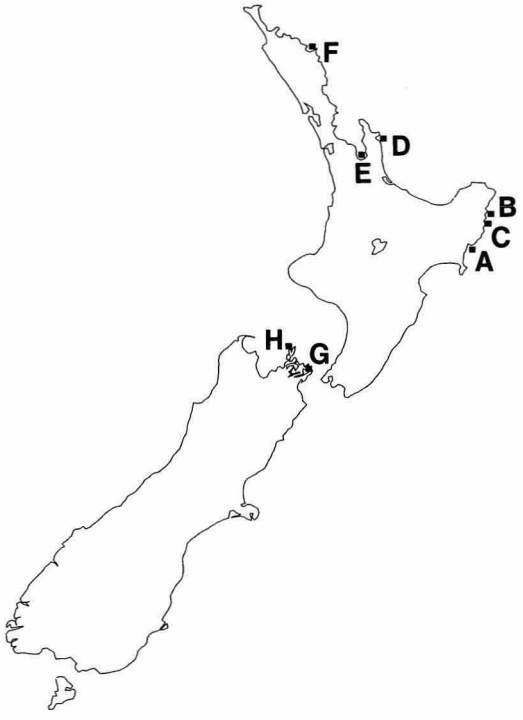

FIGURE 1. Landings made from the *Endeavour*, 1769–1770. *A*, Poverty Bay, 9–10.10.1769; *B*, Anaura Bay, 20.10.1769; *C*, Tolaga Bay, 23–29.10.1769; *D*, Mercury Bay, 4–15.11.1769; *E*, Waihou (Thames) River, 20.11.1769; *F*, Bay of Islands, 29.11.1769–5.12.1769; *G*, Ship Cove, Queen Charlotte Sound, 16.1.1770–6.2.1770; *H*, D'Urville Island, 27–30.3.70.

THE COLLECTORS

Potentially, the entire ship's crew could have collected insects. There was plenty of evidence to suggest that the sailors collected other animal species for the naturalists (e.g., fish and shells), so they might also have collected insects when the routine of the ship would let them or they encountered insects in the course of their labors. In practice, however, the crew probably collected only a very small proportion, with an emphasis on the larger, more striking species. The naturalists, Joseph Banks and Daniel Solander, were the principal participants in field excursions made primarily to collect specimens, and probably directed the use of any insect nets they might have had. They were sometimes accompanied by other members of the scientific party, their servants, and frequently by Cook himself. As the expedition's chief artist, Sydney Parkinson had a close association with the plants that were collected and was bound to have had some encounters with insects. His work prior to the voyages showed that he was skilled at illustrating them, but he did not draw any from New Zealand. Banks had collected insects on his earlier expedition to Newfoundland and Labrador, where he was virtually the sole scientific investigator. Some of that collection was later drawn by Parkinson who, incidentally, drew only one invertebrate, a mollusk, while in New Zealand waters. Plant and insect illustration and description were often closely linked in those days, which suggests that Banks, with his general supervision of the collections as a whole, and his specific interest in plants, also had a good deal to do with the insect collections. Without his presence and his interests, the collections might have been far poorer.

THE EQUIPMENT

One of the most widely quoted extracts from Beaglehole's editing of Banks' journal[3] states that they took with them "all sorts of machines for catching and preserving insects." This is probably less than it appears for the reason that the term "insects" was at that time stretched to include marine invertebrates. Hence, the quotation may have been referring to contraptions other than the butterfly nets, pins, and collecting and storage boxes they undoubtedly took with them. Elsewhere, Beaglehole (1962) refers to a list of items that Banks proposed to take with him on the second voyage (*Resolution* and *Adventure*), which included "magnifying glasses, microscopes and wire catchers for insects and birds." Although Banks' plans for the second voyage were considerably more grandiose than the first, we can assume that similar gear accompanied Banks on the first voyage. They were also in possession of a number of natural history works, but few of these would have been of much assistance in identifying insects.

[3] In a letter from Ellis to Linnaeus (Beaglehole 1962).

THE TIMES AND LOCATIONS

The localities and the time and duration of each visit are given in Figure 1. The voyage in New Zealand waters happily coincided with the period in which the greatest number of insects could be expected to be seen and collected, i.e., the flowering season, spring and early summer. Only the stop at D'Urville Island, well into autumn, was unlikely to have produced much in the way of specimens.

It is clear from the voyage records that the personnel from *Endeavour* did not penetrate very far inland. Apart from apprehensions about encountering Maoris some distance from the security of their ship, there was also a need to ration their time. In any event, there was an abundance of botanical and zoological material from the coastal regions; more than enough for those who were responsible for its cataloging, illustration, and description. Consequently, the terrain explored included the beach, the fringing vegetation and forests, as well as nearby estuaries. Occasionally, they would make their way some distance up a river (e.g., the Waihou) or ascend a nearby hill (e.g., at Ship Cove).

THE INSECTS COLLECTED

A complete list of the insects collected by the *Endeavour* expedition is provided in the Appendix to this paper with the results of our collecting. In light of what we know of the present-day fauna, it contains some surprising omissions and some equally surprising inclusions. In between these two extremes lie a number of species, some of which are striking enough to attract a collector's attention and others which, because of their unassuming appearance and likely association with plants and their flowers, we consider to have been picked up in the process of plant or other specimen collection. This includes the gathering of plants for food or wood for fires. The insects are discussed below within five assumed categories.

Conspicuous Species Actively Pursued

This group contains those specimens whose size and appearance was sufficiently striking to attract the attention of the naturalists or their assistants. Further, many of those indicated would have required active pursuit with a net, some being quite difficult to capture. The species are the following:[4]

Hemiptera
- *Amphipsalta cingulata**
- *Amphipsalta zelandica* (Boisduval)*
- *Rhodopsalta cruentata***
- *Kikihia muta***
- *Notopsalta sericea* (Walker)

Lepidoptera
- *Bassaris gonerilla**
- *Bassaris itea**

Diptera
- *Anabarynchus bilineatus**
- *Heliophilus trilineatus**
- *Pilinascia cingulata**

Hymenoptera
- *Ichneumon lotatoria*
- *Degithina sollicitoria*
- *Levansa decoratoria*
- *Sphictostethus fugax*
- *Sphictostethus nitidus*

Coleoptera
- *Neocicindela tuberculata**

This list represents almost half the number of insects collected on the first voyage and is an indication that the naturalists had at least some enthusiasm for collecting and probably spent some time going about it. With plants as their priority and other animal groups also taking their attention, as well as their observations of the Maoris, the proportion of time devoted to entomology was not too unreasonable. On the other hand, their overall collection rate was roughly only one species of insect for every day the *Endeavour* was anchored somewhere off the New Zealand coast.

Most of the species listed above are prominent by virtue of their activity, color and/or markings. In the case of the cicadas, their sound as well as their size would have attracted attention. The capture of the large wing-clapping cicadas, *Amphipsalta*, fortuitously illustrates something about the approach of these early naturalists to the collection of insect specimens. Although all four specimens of *Amphipsalta* were cataloged under the species name *cingulata* by Fabricius, subsequent examination has shown that, in fact, the collection includes representatives of each of a pair of cryptic species, *cingulata* Fabricius and *zelandica* (Boisduval) (Dugdale and Fleming 1969). Since *cingulata* is restricted to the North Island and flies in November–December, whereas *zelandica* is in both islands but flies in January–March, it was concluded by Dugdale and Fleming that the specimens of the former must have come from Mercury Bay or Bay of Islands, whereas those of the latter came from Ship Cove. The naturalists therefore were not content with a specimen from a single locality, but they clearly took more of "the same" when they again confronted large singing cicadas at Ship Cove.

The inclusion of *Notopsalta sericea* (Walker) in our list requires some explanation. This small black cicada attracted our attention when examining cliffside vegetation at both Mercury Bay and Bay of Islands. Its absence from the Fabricius insects seemed surprising to us when the naturalists had clearly been interested in securing cicada specimens. How-

[4] In all these lists, * indicates two specimens collected; ** indicates more than two specimens collected by Banks et al.

ever, when the "secondary" Banks specimens were examined (by GWG) in Fabricius' personal collection, it was discovered that an unlabeled male specimen of this endemic New Zealand species was pinned alongside the specimen of *Rhodopsalta cruentata*. We believe that it represents a genuine Banks collection specimen and is evidence that *Notopsalta* was indeed collected in New Zealand during the first voyage but that Fabricius overlooked it as he went through the insects to describe them. He described insects from Cook's second, and, possibly, third voyage to New Zealand, but timing and location favor the above interpretation with respect to *N. sericea*.

Conspicuous Species Passively Found

Here we include a few species of insects which, by virtue of their size or color, are sufficiently visible to attract the attention of the naturalists while going about their general collecting, or might even have been retrieved by other members of the crew. All are beetles that are relatively inactive by day unless disturbed.

Coleoptera
*Lasiorrhynchus barbicornis***
Pericoptus truncatus
Stethaspis suturalis
Oemona hirta
*Coptomma variegatum**
Navomorpha lineatum

Of all the insect specimens collected in New Zealand, those of *Lasiorrhynchus barbicornis* were the most likely to have been selected because of their eye-catching appearance. This large (up to 75 mm), sexually dimorphic brenthid, the most striking of all New Zealand's beetles, was encountered in large numbers on a dead karaka tree (*Corynocarpus laevigatus*) during our visit to Ship Cove. The fact that four specimens were taken on Cook's voyage indicates that they might similarly have stumbled upon such a tree, and indeed they encountered karaka at virtually every landing place. The remaining five species we have placed here are not so conspicuous, and we cannot be at all sure how they were detected. Nevertheless, even if we assume passive (or "accidental") discovery for all this group, they still represent an unexpectedly small proportion of the entire *Endeavour* collection, especially when we consider that the passive method of collection is the normal one by which nonentomologists tend to procure insect specimens. The two large (20–27 mm) scarabaeid bettles (*Pericoptus truncatus*, *Stethaspis suturalis*) were very possibly accidental discoveries. Both are crepuscular species and may have been heard or seen at dusk when their activity could attract attention, or, alternatively, single dead specimens may have been picked up. *Pericoptus* larvae were plentiful on the east coast beaches (North Island) at the times of our visit, but no adults were seen.

The remaining three large longhorn beetles placed in this group are sufficiently visible to have been collected by virtue of their appearance, but we consider that it is more likely they were taken as part of the plant specimen collections.

Insects Taken with Collections of Wood

Species possibly associated with wood-gathering activities include the following:

Coleoptera
Thelyphassa lineata
Pristoderus scaber
Ambeodontus tristis

The expedition put local timber to a variety of uses. Apart from firewood, it was useful for boat maintenance, for repairing casks, and for the erection of temporary shelters, and shrubs such as manuka were used for making brooms. Since many of the common insects currently found under beach driftwood were absent from the *Endeavour* collections, we can assume that this was not a prominent source of firewood and perhaps the crew preferred to use standing wood from the forest. It seems unlikely that the naturalists themselves spent much time searching rotten wood or looking under bark for insects (they were not entomologists!) so that what came to light from this source was probably a result of the activities described above in the procurement of wood.

Although 16 of the 25 species of beetles collected are wood-borers in either dead or living timber during their larval stages, it is unlikely that the gathering of wood led to the

discovery of the adult specimens. Almost inevitably, such insects become known first by the casual location of adults, and their larval hosts are only determined later by more intensive research. In the present context, the exception might be *Pristoderus scaber*, a moderate-sized flattened, cryptic beetle normally found under bark. It is possible that some of the larger cerambycids, especially *Ambeodontus tristis*, were spotted on tree trunks or cut timber and that the oedemerid, *Thelyphassa lineata*, could have been associated with soft rotten wood. We consider it more likely, however, that they were found on flowers or with plant collections (see below).

Insects Taken with Carrion

Two of the beetles are carrion species:

Coleoptera
- *Creophilus oculatus***
- *Saprinus detritus*

Some specimens of already dead animals were almost certain to have been obtained during excursions ashore. The Maoris traded large quantities of fish, mostly fresh, but a little of it may have been dried. A few bird skins also might have featured in the bartering, but collection of these was miniscule compared with subsequent expeditions. Shells discarded on rubbish heaps might have been examined or picked up. Any such dry or decayed animal materials are likely to have transported carrion beetles to the chartroom table, from whence their acquisition as an insect specimen would require no special effort. Three specimens of *Creophilus oculatus*, New Zealand's largest carrion staphylinid (19 mm), were taken and one of *Saprinus detritus* (5 mm), a histerid well known in New Zealand for over 100 years under the name of *S. pseudocyaneus* White (see Kuschel 1987). The Fabricius description of *C. oculatus* records it as "in n. Hollandia et Zelandia," indicating that it may have been found in both New Zealand and Australia by this method.

Insects Taken with Living Plant Material

In this category the following have been considered:

Coleoptera
- *Pyronota festiva**
- *Pyronota laeta*
- *Coccinella leonina**
- *Thelyphassa lineata**
- *Hybolasius cristus*
- *Selenopalpus cyaneus*
- *Xylotoles griseus***
- *Xylotoles lynceus*
- *Oemona hirta*
- *Ambeodontus tristis*
- *Coptomma variegatum**
- *Navomorpha lineatum*
- *Navomorpha sulcatum**
- *Zorion minutum*
- *Nyxetes bidens**
- *Catoptes interruptus**
- *Rhadinosomus acuminatus***
- *Stephanorrhynchus attelaboides*

It has not been clearly established that the naturalists "beat" the plants for insects. Beating trays were not mentioned, nor is there any indication in their writings that the naturalists spent time catching insects in this way. We can assume that if they had spent much time beating vegetation, they would have taken many more insects than those described by Fabricius. It is evident that plant collection was a priority of Banks and his fellow naturalists and, with the exception of D'Urville Island, fairly substantial numbers [between 40 and 214 (Hatch 1981)] of botanical specimens were collected at each port of call—numbers far in excess of animal species collected. Both flowers and foliage were collected when the opportunity arose. Also, plants were collected in large quantities for eating, particularly scurvy grass (*Lepidium oleraceum*) and wild celery (*Apium australe*). Insects might have been attached to these plants.

The affinity between the insects and certain species of plants varies substantially from the monophagous host relationship between *Rhadinosomus acuminatus* and *Halorhagis erecta* to the aphidivorous ladybird *Coccinella leonina*, where the plant association depends on the presence of aphids.

Banks and Solander encountered *Halorhagis* at virtually all locations visited and, we assume, found *Rhadinosomus acuminatus* (10–11 mm) at some stage on examples collected,

securing four specimens of this strikingly shaped weevil. We came across this plant at Cook's Cove, Tolaga Bay, without weevils and at Buffalo Beach, Mercury Bay, and Ship Cove, Queen Charlotte Sound, with weevils. At Anaura Bay, large numbers of *Zorion minutum* (6–7 mm) came to our notice on flowers of the diurnal stridulating grasshoppers (*Xiphidium*) and field crickets (*Pteronemobius*) is were beaten from rangiora (*Brachyglottis repanda*) and whau (*Entelea arborescens*) flowers at this locality.

It is possible that some insects remained attached to the plant or its flowers until examined by Banks, Solander, and Parkinson on board the ship. It is highly likely that they carried some sort of sack or container on shore in which to collect specimens, and that insects that had become detached from the plants were found in the container. Other vegetable matter such as manuka (used for brooms) is another possible source, since several insect species are associated with this plant, especially when in flower. This material could have been bundled up for transport back to the ship, but being in the care of those less likely to take an interest in insects, it was probably not a major source of specimens.

INSECTS OMITTED FROM THE COLLECTION

Perhaps the most pertinent point about this first collection of insects from New Zealand, and the one that attracted our initial interest, was the absence of many of the larger, more attractive, and distinctive New Zealand species. Even allowing for the limited objectives as far as insects were concerned, it is still difficult to understand why the naturalists did not collect stick insects (Phasmida), dragonflies (Odonata), grasshoppers, crickets and wetas (Orthoptera), cockroaches (Blattodea), or earwigs (Dermaptera). All were very much in evidence during our brief visits to the sites.

We conclude that they did not look for insects in several important habitats. First, among the driftwood on sandy beaches. We tended to probe this profitable zone, particularly during inclement weather, finding many species of beetles and a few other insects omitted from the first Cook collections, e.g., Coleoptera: *Chaerodes* spp., *Thelephassa diaphana* Pascoe, *Notobia australasiae* (Dejeun), *Rhytisternus miser* Chaudoir, *Ceratognathus parryanus* Hope, *Cafius littoreus* Broun; Dermaptera: *Anisolabis littorea* (White); Chilopoda: *Cormocephalus rubriceps* (Newport).

Second, the naturalists seemed to ignore logs, tree trunks, and rotten wood generally, which is perhaps not surprising when their prime concern was collecting plants with flowers or seeds. Thus, there are no carabid beetles (apart from *Neocicindela*), no wetas (Stenopelmatidae or Rhaphidophoridae), and no cockroaches, to name but a few prominent absentees.

Third, the naturalists' shunning of the more fragile freshwater insects brings us to consider the problems that preservation of specimens may have presented. Beetles are easily pinned and are durable; butterflies were pinned and spread, an art that existed at the time; but perhaps they deliberately avoided soft-bodied insects such as phasmids (or perhaps they had been collected, only to be destroyed by accident or vermin later in the voyage). Alcohol and jars were on board the ship, but these might have been considered unsatisfactory for preserving insects and could have been reserved for the more delicate marine invertebrates and for the smaller birds and fish. Most of the insects were probably pinned in the customary way,whatever their size, with pins of larger diameter than those used today.

We are aware that some species were deliberately overlooked by Banks and the others, simply because they thought they were the same as Northern Hemisphere forms: "a few Butterflys and Beetles, flesh flies very like those in Europe, Mosquetos and sandflies maybe exactly the same as those of North America," said Banks in his summing up of the New Zealand fauna. However, this approach would not explain the absence of such insects as wetas and stick insects.

During our visits to the Cook landing sites, certain insect species were drawn to our attention—ones that the foregoing arguments suggest should have been collected, yet are conspicuously absent. We select a few for discussion here.

If cicadas attracted the naturalists' attention, why not crickets and other stridulating orthopterans? We have suggested why they missed New Zealand's wetas, but the absence of the diurnal stridulating grasshoppers (*Xiphidium*) and field crickets (*Pteronemobius*) is more surprising. Even the abundant lowland silent grasshopper, *Phaulacridium marginale* (Walker), was not included. Perhaps the invasion by adventive grasses has had a dramatic effect on the abundance of these species. Although endemic, these species that are so common today may have been quite scarce at the localities where they landed if dense forests came almost to the water's edge.

Another insect group that clearly attracted the naturalists' attention was the butterflies, where again multiple specimens of quite difficult-to-catch insects figured prominently in their collection. There are, however, two interesting omissions in the butterflies and, of course, they ignored the moths altogether. First, no copper butterflies (*Lycaena*) were included—an omission that a subsequent Cook voyage made up for [*L. salustius* was described by J. C. Fabricius from New Zealand in 1793, but see Andrews (1986) for speculation on the origin of this specimen]. It seems inconceivable that they did not encounter either *L. salustius* or *L. rauparaha* (Fereday), both of which are common endemic coastal insects with flight periods that extend across the timing of all their landings. The larval food plants (species of *Muehlenbeckia*) were collected by them at all sites except Thames, Bay of Islands, and D'Urville Island. One possible explantation is already discussed, namely that they considered these butterflies to be the same as their European counterparts and thus of little interest. Another is that they did actually collect some *Lycaena* specimens, but the specimens became separated from the main Banks collection, only to turn up later when Fabricius visited Dru Drury, a London silversmith who was known to purchase foreign butterflies from expeditions. In the Fabricius description, *salustius* is credited to India, suggesting it might well have been separated from the New Zealand material.

The second butterfly omission relates to another lycaenid genus, *Zizina*, the common grass blues, for which there may be an entirely different explanation. Today, *Z. labradus* is probably the most common butterfly in Australia and New Zealand, and it is present at open stony sites around the coast. Its absence in 1770 was related to a lack of its larval food plants (introduced clovers), as discussed by Gibbs (1980). On the other hand, the endemic species, *Z. oxleyi*, was, so far as we know, restricted to more inland localities and is not found anywhere near the Cook landing sites today.

Finally, in this consideration of omissions, we must refer to the native bees (Colletidae: especially *Leioproctus imitatus* Smith) whose numbers on sandy beaches at Mercury Bay and Bay of Islands impressed us. In the light of the few ichneumonids and pompilids in the Cook collection, why were these conspicuous hymenopterans not taken? We have no suggestion other than the possibility that the naturalists considered them dull, similar to bees elsewhere, and generally not sufficiently interesting to be collected. Perhaps this is a clue to their selection of specimens; Banks and his colleagues may have been biased towards more attractive specimens (butterflies, colored wasps, and beetles), ignoring those with less appeal. Such tendencies are exhibited by modern collectors, so we can excuse their 18th century counterparts for choosing specimens for their beauty rather than for their representativeness.

DISCUSSION: CONSIDERATION OF THE QUESTIONS POSED

At this point we can perhaps attempt to answer the questions raised earlier in this paper.

1. The Collectors and Their Preservation Methods

The collectors have already been named: Banks, Solander, Parkinson, and their assistants and, to a lesser extent, the ship's officers and crew. Reference to collecting technique also has been made above. Although generally referred to as the "Banks collection," there is

no record of who actually prepared the specimens. All the insects were pinned and dried for preservation. The weight of pins used was heavy by today's standards, thereby placing a lower limit on the size of specimens. Butterfly wings appear to have been spread on the voyage, hence necessitating a period of drying on a setting board, while those of cicadas were not [the Banks specimens of *Amphipsalta* shown in Dugdale and Fleming (1969) have subsequently been half-spread]. The specimens carry neither locality labels nor numbers, and there are no records to suggest that they were ever labeled individually apart from the assignment of species names in Fabricius' handwriting. The country of origin appears to have been noted only by means of "external" labels or separate storage boxes, a fallible system that could easily lead to the sort of mix-ups that crept into the Fabricius descriptions [i.e., six of these New Zealand species were recorded as being from "nova Hollandia" (= Australia) and one from "Brasilia"].

Although the collection was rearranged to some extent by Fabricius, it was apparently in some state of disrepair when visited by N.S. Svederus in 1785. In spite of insects having a lower priority than some of the other biological collections, proportionately more of the insects have survived to the present day. Many of the specimens have suffered from the ravages of time and are dirty, or parts of them are missing. Nevertheless, they are still recognizable (Radford 1981). The Diptera have suffered most, with some specimens existing as only an isolated wing or even merely a pin with a Fabricius label on it (Zimsen 1964).

2. *How Did They Obtain Their Specimens?*

Were the insects deliberately sought after or were they collected inadvertently? We have argued that the unexpected composition of the collection is evidence for both views. On one hand, the naturalists expended some effort catching specimens, particularly large colorful and/or audible species that would have required a butterfly net, but on the other hand, they seemed to rely to a large extent on chance encounters. Many species (all Coleoptera) were plant associates, and we believe their recovery from plants was more accidental than deliberate. Had the naturalists systematically used beating trays for insects, they would have removed a far wider range of species. It is difficult to imagine why the larger orthopterans and phasmids would not have been present at the time of the collections; had they been seen, they surely would have excited the naturalists' attention. We conclude that apart from the actively pursued insects from open, accessible habitats, no special effort was made to find insect specimens elsewhere.

So this was very much the sort of collection that one would expect from a group that had limited time and priorities other than searching for insects. We can say, therefore, that the collections did not entirely reflect the availability of species at the time.

3. *Is There Any Evidence for Changes in the Insect Fauna Since Their Visit?*

One of the most striking features of this first sample of New Zealand insects is that it contains several species that are seldom encountered today and that would be regarded as rarities by current entomologists. From our considerations of the collecting methods and approach to field entomology, it is inconceivable that the naturalists deliberately sought "rarities" in a place where just about all natural history specimens were new and unfamiliar to them. They probably "chose" which insects to catch from their color, size, and general attractiveness (although perhaps avoiding ones that looked the same as those in Europe). Thus, when we rank some of their species as "rare" today, the chances are that the abundance of these species has declined since 1769–1770. The following examples illustrate possible declines.

The eye-catching dipteran, *Pilinascia cingulata*, is scarcely seen today, yet Cook's naturalists probably took two specimens (see Zimsen 1964). Again, the ichneumonid, *Levansa decoratoria*, seems a rare wasp judging from its absence in both the National Museum collection and the New Zealand Arthropod Collection, DSIR. They collected two other black

and orange ichneumonids that superficially look very alike but are placed in different genera (an example of Mullerian mimicry?): *Ichneumon lotatoria*, although recorded as a parasitoid of *Wiseana*, is quite a scarce species today; and *Degithina sollicitoria*, which is seen more frequently. The fact that Cook's naturalists took a total of five species of moderate-sized, active hymenopterans (i.e., including the two species of *Sphictostethus*) suggests that perhaps the person with the butterfly net was being selective and made a special effort to obtain these particular insects.

Within the Coleoptera the naturalists collected two specimens of *Coptomma variegata*, a large cerambycid (20–22 mm), which Hudson (1934) noted was "now very much rarer than it was in Wakefield's time" (around 1872); and two specimens of *Nyxetes bidens*, a two-spined black weevil, which is a surprising inclusion in view of its spasmodic occurrence today. This is all the more surprising since they omitted to collect any specimens of *Scolopterus*, black spiny weevils that are far more abundant than *Nyxetes* in flowers today (we found them at several sites). Two other beetles in the collection are worthy of mention. The cerambycid, *Xylotoles lynceus*, occurs at Ship Cove on the introduced tall fescue, *Festuca arundinacea*, where we located it readily on our visit. Clearly, it was an element of luck that brought the early naturalists to this extremely local insect. Its endemic host plant is not known. Although a common insect, the inclusion of *Selenopalpus cyaneus* also is a surprise. This dull-blue oedemerid beetle, normally regarded as a subalpine species associated with speargrass and other flowers (Hudson 1975), has not otherwise been recorded from lowland coastal sites. Perhaps Cook's efforts to climb the hills around Ship Cove for views of the waterway between the North and South Islands enabled the collectors to find this beetle, but there are no recent records below 700 m.

Our conclusion is that this 200-year-old insect collection provides circumstantial evidence for the familiar pattern of a decline in certain endemic species since the first European contacts with New Zealand. Sweeping changes to habitats are referred to below, but even where the habitat remains reasonably intact (as at Ship Cove), the introduction of pathogens, parasites, predators, and competitors could all have had an impact as could the use of chemical insecticides.

Not only does the collection provide evidence for the decline of certain endemic insect species, but it also focuses attention on the rise of adventive species. Present-day entomologists visiting the Cook landing sites could not fail to notice that the most conspicuous insects today are mostly introduced species. Thus, a modern collection of this nature would include green vegetable bug (*Nezara viridula*), bumble bee (*Bombus* spp.), honey bee (*Apis melifera*), European wasp (*Vespula* spp.), white-spotted ichneumon *Echthromorpha intricatoria*), white butterfly (*Pieris rapae*), and black beetle (*Heteronychus arator*), to name but a few we found conspicuous.

4. How Different are the Landing Sites Today?

At least some degree of habitat change has taken place at each of the localities visited by Cook. The North Island east coast sites, in particular, have been greatly modified by bush clearance and farming, to a point where only sparse scattered patches of indigenous forest remain. The Anaura Bay Reserve is, in effect, the only "natural" (although in far less than original condition) area of forest remaining near one of Cook's east coast landings, and in it we found four of Banks' species. The potentially attractive and historically significant watering place at Tolaga Bay has been allowed to remain almost totally devoid of natural vegetation, and the stream itself is merely a trickle through grazed pasture. Patches of seminatural vegetation in Mercury Bay (Shakespeare Cliff and Ohuka Beach) allowed us to find some of Banks' insects (seven species taken).

The vegetation of the Bay of Islands was already modified when Cook arrived there and is even more so now (we took six of Banks' species on Moturua Island). But Ship Cove had a covering of natural forest vegetation,

and it still does, apart from the invasion of adventive grasses along the foreshore, making it by far the least modified of all the landing sites. The *Endeavour* spent most time there (14 days), probably allowing the naturalists to obtain their best sample of insects (we located ten of their species).

In short, the fate of Cook's landing sites is symptomatic of modifications to New Zealand as a whole. There is no evidence that any of the species collected have become extinct (unlike some of the bird species they observed), but certainly some are reduced in abundance to the point where a modern entomological expedition with modern collecting equipment would not have any hope of repeating the list of species found so "easily" by these early naturalists. Still less chance would present-day naturalists have if they used the methods of Banks and Solander. Our brief foray (5 days collecting versus 40 days *Endeavour* was moored in New Zealand waters) to their sites yielded only 19 of the 40 species taken in 1769–1770. By contrast, most of the molluscan shells they collected still can be regarded as common today.

5. Is It Possible to Establish More Precise Localities for Some Species?

In spite of the absence of any locality data with the actual specimens (see above), several authors have attempted to establish type localities for the Banks collection material. Thus, Kuschel (1969) concluded—from its present known distribution and the schedule of *Endeavour*—that *Catoptes interruptus* must have been collected at Tolaga Bay and designated this its type locality. Dugdale and Fleming (1969) discuss the *Endeavour* voyage in relation to the collection of the two species of *Amphipsalta* and restrict the type locality of *cingulata* "to Bay of Islands, where Banks and his companions collected between November 29 and December 4, 1769." However, revisions of *Xylotoles* (Breuning 1950) and the oedemerid beetles (Hudson 1975) make no attempt to assign localities for type specimens.

Few species are sufficiently restricted in their distribution or time of appearance, or are so geographically variable that they can be pinpointed to one of the localities. In most cases, two or more possible locations could be assigned to the insects, as is indeed the case for the *Catoptes* example quoted above (Kuschel 1969). It is easier to say where the insect was not collected.

Our present collection records are included in the Appendix in the hope that they may shed some light on the localities. Of those listed, *Xylotoles lynceus* is the only species for which we can confidently assume a single possible collection site at Ship Cove. For the others, there must remain uncertainty, at least until careful revisions are made using up-to-date distribution records.

CONCLUSIONS

This assessment of the first insects known from New Zealand has emphasized the "accidental" collection methods we consider to have led to the discovery of many of Banks' specimens and examined some of the more surprising inclusions and omissions. By comparing the kinds of insects gathered over 200 years ago with those of today, the Banks collection serves to remind us of the impact of Europeans on the endemic invertebrate fauna —an impact of which we have remarkably little direct evidence. The complete list of actual specimens taken on the *Endeavour* voyage will probably never be known for certain, but we are confident that those we have included are first voyage material. Some others that are not included here [e.g., *Calliphora quadrimaculata* (Svederus) and *Lycaena salustius* (Fabricius)] also may eventually be attributed to this voyage. This review has shed some additional light on the activities of the first naturalists in New Zealand. It also reveals that Fabricius, one of the preeminent entomologists of his era, suffered some human lapses now and again. He could excel as a systematist for instance when he differentiated two sibling species of *Pyronota* or the pairs of similar pompilids and ichneumonids, yet he failed to recognize the two cryptic *Amphipsalta* species and placed a

clearly distinct New Zealand cicada in his own collection, somehow neglecting to name it.

APPENDIX

New Zealand insects collected on *Endeavour* voyage: This table lists the confirmed first voyage material and indicates where we located our specimens.

Hemiptera	
Cicadidae	
Amphipsalta cingulata	Mercury Bay, Bay of Islands, Ship Cove
Amphipsalta zelandica	
Rhodopsalta cruentata	
Kikihia muta	Ship Cove,
Notopsalta sericea	Mercury Bay, Bay of Islands
Lepidoptera	
Nymphalidae	
Bassaris gonerilla	Ship Cove
Bassaris itea	
Diptera	
Therevidae	
Anabarynchus bilineatus	
Syrphidae	
Heliophilus trilineatus	
Pilinascia cingulata	
Hymenoptera	
Ichneumonidae	
Ichneumon lotatoria	
Degithina sollicitoria	
Levansa decoratoria	
Pompilidae	
Sphictostethus fugax	Ship Cove
Sphictostethus nitidus	Ship Cove
Coleoptera	
Carabidae	
Neocicindela tuberculata	Bay of Islands, Ship Cove
Histeridae	
Saprinus detritus	
Staphylinidae	
Creophilus oculatus	
Scarabaeidae	
Pericoptus truncatus	Gisborne, Tolaga Bay, Mercury Bay
Stethaspis suturalis	
Pyronota festiva	Mercury Bay, Bay of Islands
Pyronota laeta	
Colydiidae	
Pristoderus scaber	
Chrysomelidae	
Coccinella leonina	
Oedemeridae	
Thelyphassa lineata	
Selenopalpus cyaneus	
Cerambycidae	
Hybolasius cristus	Mercury Bay
Xylotoles lynceus	Ship Cove
Xylotoles griseus	Anaura Bay, Mercury Bay, Ship Cove
Oemona hirta	Bay of Islands
Ambeodontis tristis	
Coptomma variegatum	
Navomorpha lineatum	
Navomorpha sulcatum	Anaura Bay, Bay of Islands
Zorion minutum	Anaura Bay
Curculionidae	
Nyxetes bidens	

Catoptes interruptus	Anaura Bay
Rhadinosomus acuminatus	Mercury Bay, Ship Cove
Stephanorrhynchus attelaboides	
Brenthidae	
Lasiorrhynchus barbicornis	Ship Cove

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