

**SCIENCE & RESEARCH SERIES NO.75**

**DISTRIBUTION, CONSERVATION STATUS AND SOME  
FEATURES OF THE NATURAL HISTORY OF *Dorcus*  
STAG BEETLES (COLEOPTERA: LUCANIDAE)**

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Published by  
Head Office,  
Department of Conservation,  
P O Box 10-420,  
Wellington,  
New Zealand

ISSN 0113-3713  
ISBN 0-478-01639-5

© October 1994, Department of Conservation

#### Cataloguing-in-Publication data

Sherley, Gregory H. (Gregory Howard), 1956-  
Distribution, conservation status and some features of the natural  
history of *Dorcus* stag beetles (Coleoptera: Lucanidae) / by Greg  
Sherley, Chris Green, and Keith Owen. Wellington, N.Z. : Dept. of  
Conservation, 1994.

1 v. ; 30 cm. (Science & Research series, 0113-3713 ; no. 75.)

Includes bibliographic references.

ISBN 0478016395

1. Beetles--New Zealand. I. Green, Chris. II. Owen, K. L.  
(Keith Leslie), 1949- III. Title. IV. Series: Science & research  
series ; no. 77.

595.760993 20

zbn94-090553

**Keywords:** Stag beetle (Coleoptera: Lucanidae, *Dorcus* spp), conservation status, ecology, management, research, Coromandel, Northern Kaimai Ranges, Mokohinau Islands, Harihari District West Coast

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(COLEOPTERA: LUCANIDAE)**

by

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**ABSTRACT**

Information about the life history, distribution and conservation status of *Dorcus* stag beetles was collected during surveys carried from 1991 to 1993. The study aimed to assess the conservation status of three species known from the Mokohinau Islands, Coromandel Peninsula region, and northern Kaimai Range, and to determine whether it was feasible to carry out an analogue study on the common West Coast stag beetle (*D. helmsi*) in lieu of studying the much rarer Mokohinau Island and Coromandel species. While the new species found on Mt Moehau and *D. auriculatus* can be classified as "vulnerable" it is almost certain that *D. ithaginis* is restricted to Stack H in the Mokohinau Islands and can be classified in IUCN terms as "endangered". It was considered inadvisable to carry out an analogue study of *D. helmsi* on the West Coast in lieu of studying *D. ithaginis* because the latter's habitat and behavioural ecology appears to be substantially different. Aspects of the life history of the four species studied and recommendations for further survey and research are described.

**1. INTRODUCTION**

Stag beetles (Coleoptera: Lucanidae) are best known for their sometimes extreme sexual dimorphism. The males' jaws are often relatively enormous compared with the females'-a consequence of sexual selection for males with correspondingly superior reproductive fitness (Darwin 1871, Hudson 1920). The term "stag" relates to the shape of the branched mandibles and the presence of tines or prongs which look like the antlers of male deer (Hudson 1934). The jaws on the males of some species (like those in New Zealand) exhibit allometry-proportionately larger jaw size within a species with increasing body size (Holloway 1961). Stag beetles occur worldwide and have been the subject of much research-especially related to evolutionary theory (Thornhill 1979 and references therein).

What little is known of the distribution, conservation status or natural history of stag beetles in New Zealand was summarised in Holloway (1963). Holloway (1960) gave a historical review of Lucanid classification and described the New Zealand taxa in Holloway (1961). A further taxonomic review by Holloway is under way which will

describe a new species investigated in this study and ascribe this species and the two threatened endemic species of *Dorcus* (*D. ithaginis* and *D. auriculatus*) to a new genus (Dr Beverley Holloway pers. comm.). Other authors have related anecdotal observations on stag beetles, e.g., Walker (1984) and Meads (1990).

In the Wildlife Amendment Act 1980 *D. auriculatus* and *D. ithaginis* were listed as protected species. Both species have been described as endangered or threatened by Bell (1986), Sherley (1989) and Molloy and Davis (1992). However, little detailed field investigation supported these classifications. Their protected legal status and high conservation status prompted the present study, the aims of which were to collate all known information on their distribution and natural history; describe in detail the distribution, conservation status and natural history of *D. auriculatus*, *D. ithaginis* and *D. "Moehau"* n. sp. (Dr Beverley Holloway pers. comm.).

Given that *D. ithaginis* was previously known from only one extremely fragile and tiny area of island habitat of less than one hectare, it was essential to survey the other islands in the Mokohinau group for the species, in particular Lizard Island where the type specimen was most likely collected (Dr Beverly Holloway pers. comm.). The final aim was to investigate the natural history of *D. helmsi* which is relatively common on the West Coast of the South Island, to determine if an analogue study could be carried out on this species instead of disrupting the one *D. ithaginis* population. Because almost nothing is known about the rare *Dorcus* species, and still less is formally recorded, this report gives a detailed description of survey results and other information currently known about their life history.

## 2. SURVEY METHODS AND AREAS, CONSERVATION CATEGORIES

*Dorcus* species are mainly nocturnal and shelter under rotting logs, stones, bark or litter on the forest floor or under the bark of standing trees. Hence daytime surveys involved searching under all possible hiding places in any forest at any altitude. Care was taken to return any item shifted to its original position. On the Mokohinau Islands searching on the ground included lifting ground-hugging vegetation, fallen branches and rocks; and searching litter. Elsewhere, most effort was centred on natural routes such as ridges or existing tracks (Owen, 1991).

At night spotlights were used to search the surfaces of tree trunks for active stag beetles. Where possible the dimensions of stag beetles were measured using callipers accurate to 0.02 mm (Appendix 1). Crude descriptions of the vegetation cover in the vicinity of each stag beetle discovery were made together with altitude, geography and weather conditions (for night time observations). Where it was recorded, search effort has been given. All grid references have been given as six figure coordinates using Department of Survey and Land Information Infomap 260 series (scale 1:50,000) or Topographical map NZMS 1 series (scale 1:63,360). The first three figures describe longitude and the last three latitude.

The study areas surveyed were: in the Hauraki Gulf and Coromandel area (Figure 1) - Mokohinau Islands, Mt Moehau, Coromandel, Te Puru, Mt Te Aroha; West Coast (Figure 2) - Harihari, Saltwater State Forest. The size and variability of habitat searched was so large that individual habitat descriptions where stag beetles were found have been recorded alongside the discoveries listed in the results. Because Stack H in the Mokohinau Islands was so small, a separate description of this habitat has been given (Appendix 2).

The conservation status categories as defined by the International Union for Conservation of Nature and Natural Resources (IUCN) have been used literally by New Zealand authors (e.g., Bell (1986) or in slightly modified form (e.g., Molloy and Davis 1992). Williams and Given (1981) used the IUCN terms literally in their list of species of conservation importance in New Zealand. While new IUCN definitions have been published (Mace and Lande 1991, Mace *et al.* 1992), they are still in draft form (Mace *et al.* 1992) and not yet commonly used. Hence, for this study, the former IUCN definitions were used (after Williams and Given 1981, Appendix 3). Details of dates, search effort and locations are recorded in Appendix 4.

### 3. RESULTS

#### 3.1 Mokohinau Islands - *Dorcus ithaginis*

In the 1991 field trip (location see Figure 1) three dead males were discovered - two within the basal foliage of a clump of *Chionochloa bromoides* grass and one beneath and near the edge of a moss sward with some iceplant. The nighttime search revealed three live females and one dead female (see Appendix 4 for details of search effort). The live females were found under litter-two beneath the area of low coastal pohutukawa (*Metrosideros umbellata*) forest close to the base of a karo tree with a thin trunk and soft bark, and one near a large area of ice plant on the western side of the stack.

Two of the live females moved slowly and "froze" on being disturbed before slowly moving to bury themselves in the litter. The third female moved away quickly when disturbed. All the females were an ochrous brown colour which, together with their size and shape, gave them perfect camouflage among the dried pohutukawa leaves in the litter. The complete male bodies found were distinctly black by comparison. Numerous fragments of stag beetles were found-none of which showed any signs of rodent predation because all the breaks were along body plate sutures. All complete stag beetles were left on the island.

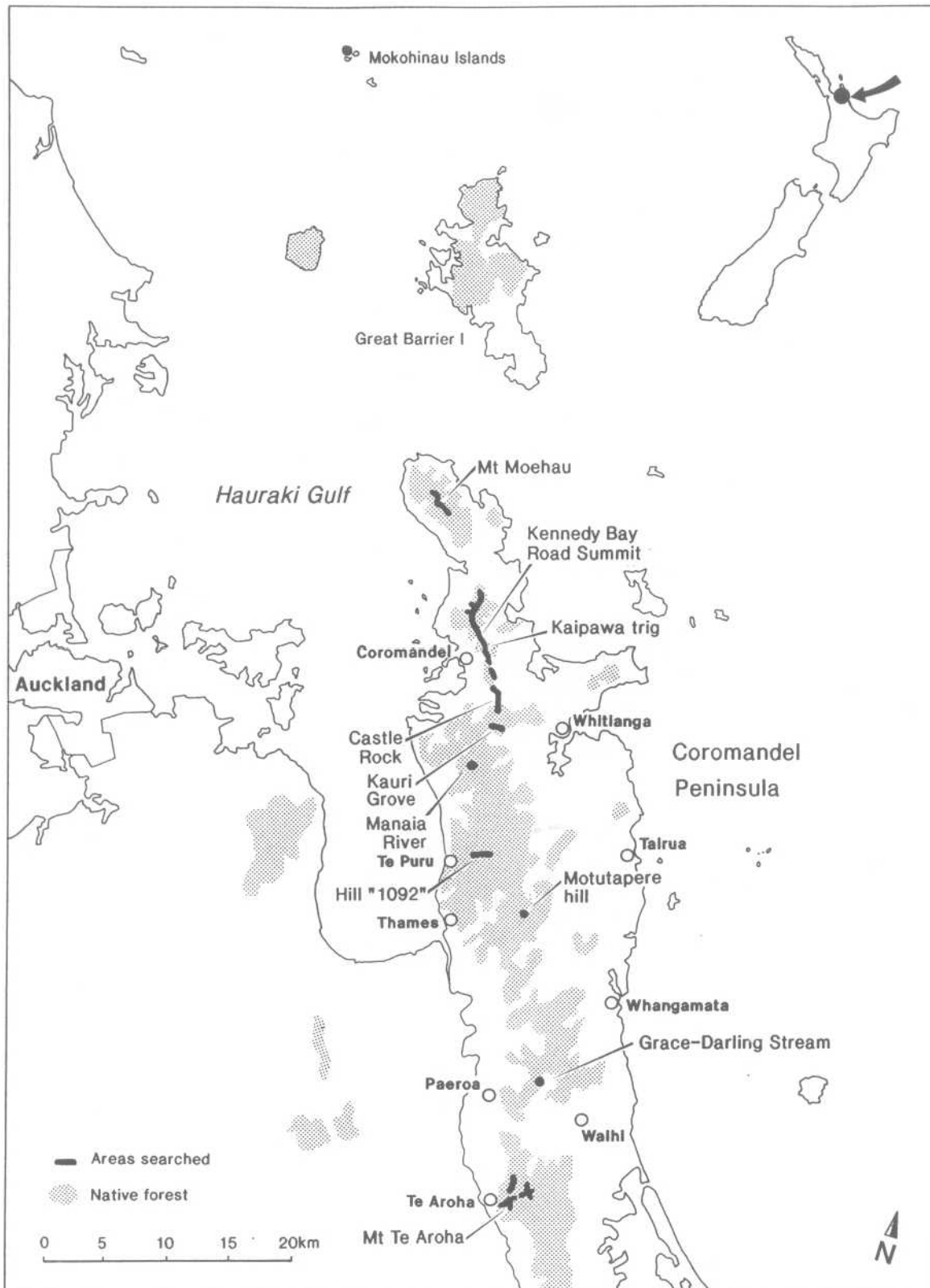
On a third survey trip to the Mokohinau Islands between 9 to 16 November 1993 two to four people searched for *D. ithaginis* on Stack H by day and night during a period of calm mild weather with no moon. No live stag beetles were found despite an increased search effort of over 13 hours by night and 4 hours by day (Appendix 4).

During each of the three trips to the Mokohinau Islands Lizard Island was also searched, including trips during both day and night on several occasions. Despite this Island being the likely type locality for *D. ithaginis* no sign of the species was found, either as complete specimens or as fragments (Appendix 4). Thus, it seems that the stag beetle has not been present on Lizard Island for some time. Fragments of the tenebrionid darkling beetle *Mimopeus elongatus* and scarab beetles were found and none of these showed signs of rat predation. Therefore it would appear that rats had also been absent from Lizard Island for some years.

Burgess Island has also been surveyed during each trip in the course of monitoring the recovery of the invertebrate fauna on the island following the eradication of kiore (*Rattus exulans*) (McFadden and Greene 1994). As on the other islands all likely habitats were searched during both day and night. In addition pitfall and pan traps were serviced and litter collected. The only large bodied beetles found included the endemic Mokohinau chafer (*Odontria sandageri*), *M. elongata* and various carabids. No fragments of *D. ithaginis* were found.

Other islands and stacks in the Mokohinau group have also been surveyed for stag beetles including Stack B, D, F, G, "Flax" Island and Sphinx Rocks (Appendix 4). All had very poor invertebrate faunas with relatively few fragments and even fewer live M.





**Figure 1** Locations searched for stag beetles in the Kaimai, Coromandel, and Hauraki Gulf areas.

*elongata*, low numbers of isopods, coastal earwigs (*Anisolabis littorea*) and native silverfish. Also few lizards were seen, and this, together with the low invertebrate numbers was consistent with having had severe predator pressure up until kiore eradication. Although difficult to land on all these islands were within the projected swimming distance for kiore from Burgess or Maori Bay Islands which had kiore present prior to 1990 (Ian McFadden pers. comm.)

During the April 1993 trip Groper Rock, an outlying island to the west of Burgess Island, in the Mokohinau Islands, was also searched (Appendix 4). High numbers of lizards and various invertebrates were found, including *M. elongata*, consistent with never having rats. However, no sign of *D. ithaginis* was found.

All other islands in the group are unlikely to have the species present due to the known presence of kiore, either currently as in the case of Fanal Island, or in the recent past, or have so little suitable vegetated habitat that the stag beetle could not survive. It therefore appears that Stack H is the only remaining locality where *D. ithaginis* survives. It has never been reported from outside of the Mokohinau Islands.

### **3.2 Mt Moehau - *Dorcus* "Moehau" n.sp.**

Thirteen male and nine female stag beetles were found by day between 6 to 8 January 1992 (location see Figure 1) including six pairs of which four were copulating. Copulation for one pair lasted at least 24 hours. Three pairs and one dead female were collected and deposited in the NZ Arthropod Collection for use by Dr Beverley Holloway in her review of the New Zealand Lucanids and description of this new species. Twenty one stag beetle larvae were found in four groups. It was presumed they were *Dorcus* sp. larvae since they were found alongside adults except imbedded into the more recent rotting wood (see below for description) and because they fitted the description in Holloway (1961).

The night time search on January 6 (Appendix 4) did not reveal any free-ranging adults. However, four larvae were found under either decaying rata (*Metrosideros* sp.) or kaikawaka (*Libocedrus bidwillii*) logs at the juxtaposition of an extensive thick sward of rice grass (*Microlaena avenacea*) and scattered *Dracophyllum traversi*. The aged and weathered logs were probably the by-product of an early fire since there were charcoal remains on some of the standing dead trees. Two pairs of larvae were found under separate logs lying in the dark top-most soil horizon or humus layer hard up against the wood that had not yet become part of the humus. The larvae occupied galleries that were larger in diameter than the body of the animal. Larvae were "C" shaped, mainly cream coloured with a translucent skin and their body was distally fattened or bulbous with grey matter inside visible through the skin. Four pairs of spiracles could easily be seen posterior to the legs. The head capsule was bright yellow. The larvae were slow moving and obviously photophobic. The location of the larvae (S10 250159) was 683 m a.s.l. on the crest of the main ridge. Weather conditions were clear, mild, no wind, temperature 10-15°C with a heavy dew on the vegetation. At the same time and location as above three copulating pairs (i.e., the pairs were joined) of stag beetles were found in the interface of the dark red-brown humus layer and the timber of the log.

These beetles were collected and subsequently identified by Dr Beverley Holloway as a new species of *Dorcus* probably endemic to Mt Moehau.

A daytime search on 7 January 1992 of the same area (and grid reference) revealed two groups of stag beetles. Under one log two females and two males (possibly two pairs, but not copulating) and one dead female were found within 20 m of the three pairs found on 6 January. Another group of three (one copulating pair and a solitary male) was found under a log within 30 m of the other groups. The copulating pair were observed coupled for at least 24 hours (Rick Thorpe pers. comm.). The logs under which the beetles were found were apparently the same species as those above, and the surrounding vegetation, altitude, aspect and landform were also similar.

A search of the main ridge to the east and south of Mt Moehau produced two males. On Little Moehau (S10 260148) a male was found under a rock which was buried about 15 cm under the surface in a rock jumble overgrown with vegetation. The dominant plant species in the area were mountain toatoa (*Phyllocladus aspleniifolius* var. *alpinus*) and kaikawaka. The site was on the main ridge facing west at 908 m a.s.l. The second male was found in a damp area dominated by Sphagnum moss bog at GR S10 263147. It was at least 25 cm below ground level under a log (unknown species). The site faced east and was off the main ridge at 800 m a.s.l.

On 8 January 1992 eight larvae which fitted the description of stag beetle larvae (Holloway 1961) were found in the region of advanced decay between the intact wood of a log (unknown species) and the ground (S10 250159). When the log was uplifted the larvae were two to three centimetres below the surface. The soil in the immediate vicinity was a deep brown-red colour tightly bound together with rice grass roots. The other dominant plant in the area was *Dracophyllum traversi*. The larvae had formed galleries by compacting the soil which often had dark coloured droppings about 2 mm in diameter. It seemed almost certain that these larvae were feeding on the advanced decaying wood of the log-not on the rice grass roots. Under another log at the same location (S10 250159) four more larvae were found which looked the same as those mentioned above but were smaller and occupied similar galleries.

At the same locality a male and a female stag beetle were found under separate logs (unknown species) amongst regenerating scrub comprising mainly toro (*Myrsine salicina*) and towai (*Weinmannia silvicola*). Their microhabitat differed from the other sites in that a thick detritus/soil layer was absent.

The final search of the Mt Moehau area was northeast of the trig. The following observations were made at grid reference S10 245157 at 793 m a.s.l. Here the area was covered in regenerating forest species up to 2 m: towai, broadleaf (*Griselinia littoralis*), tawari (*Ixerba brexioides*), *Corokia buddleioides*, mountain toatoa, toro, ponga, and some emerging rimu (*Dacrydium cupressinum*). The site was on the main ridge and faced east to southeast. One female was found about 50 cm above the ground in rotting soft wood which was a dark red-brown colour underneath a moss cover. The cavity in which the beetle was found was a natural one of about 15 cm diameter. A male beetle was found about 1.5 m above the ground in an old tree stump between two pieces of

wood. Its hiding place was completely dark and damp. Underneath this stump at below ground level another male was found in the same type of soil as others found under logs. At the same location a larva, presumed to be a *Dorcus* species was under another rotting log (unknown species) in the decaying layer between sound wood and the earth. Again it was in the characteristic gallery that the other larvae had occupied.

The last *Dorcus* found at Mt Moehau was a male at a site (S10 245157) which was predominately vegetated with kamahi and toro with emergent rimu and scattered ponga. The beetle was found under a rotting log in the same decaying zone similar to the others. The log was about 15 cm in diameter and was found at 774 m a.s.l. and the site faced south east.

### 3.3 Coromandel – *Dorcus*

No stag beetles were found in searches made between 12 and 14 January 1993 (location see Figure 1). The forest in the Castle Rock and Hodder East Road areas was highly modified, young and regenerating. Consequently there was little in the way of dead timber to search-fallen or standing. Similarly, the Kauri Grove track and a second track that leads from it to a point about 300 m below hill "422" (spot height) at grid reference T1 1393814 revealed hardly any suitable stag beetle habitat. However, despite the absence of stag beetles between "Route 25" and Kaipawa trig, there was a large volume of dead wood (mainly rata) between GR (T10 and U10) 363927 and 359928.

### 3.4 Te Puru – *Dorcus*

Three people spent 9 hours searching on 9 January 1992 (location see Figure 1) and found 7 stag beetles (later identified as *D. auriculatus* by Dr Beverley Holloway pers. comm.). Two male beetles were found at grid reference T12 395598. Their habitat was dominated by kamahi, *Coprosma macrocarpa*, miro (*Prumnopitys ferruginea*) and ponga with emergent rimu. The beetles were found under two logs 20 to 25 cm in diameter lying side by side which had fallen across the walking track and in the decaying matter between the sound timber and the soil. Their microhabitat appeared moist, but not saturated, and the beetles were found separately with no sign of larvae present. The site was 719 m a.s.l. on poorly drained ground on a level and wide ridge. Another five male stag beetles were found at the same locality but under a different log (about 1.5 m long X 0.2 m diameter) and hence with the same habitat features except these had apparently created scalloped cavities between the timber of the log and the soil/humus layer in which they were sheltering. One of the beetles was discovered on the topside of the log between some moss and the log.

On 10 January 1992 the search along the track towards Crosbie's clearing from "hill 1092" (arbitrary name based on its spot-height given on the map) revealed the pieces of one dead and two live male stag beetles. Neither of the two live stag beetles was collected so it is presumed they were *D. auriculatus* as were the others collected the previous day from the same area. The first male was found at grid reference T12 392596 in a relatively dry situation under a podocarp log (1 m diameter) in the humus layer. The surrounding forest (about 15 m high) was mainly kamahi, tawheowheo

(*Quintinia serrata*) and tawari and covered a flat wet area on the track to trig 1092. The height of the discovery site was 689 m a.s.l. and faced west.

The second live male was found under a 20 cm diameter moss-covered rotting log whose surface was scalloped forming numerous cavities between the wood and the soil layer. Between these was a layer of humus. The area was relatively dry and flat but faced west and the forest was dominated by kamahi, tawheowheo and toro. The height at this grid reference (T12 387596) was 695 m a.s.l.

The remains of the dead male were found under a rotting log (unknown species) at grid reference T12 397599.

### **3.5 Mt Te Aroha - *Dorcus auriculatus***

The results of a 65 person-hour search by 5 people between 5-7 February 1991 (location see Figure 1) have been described in detail by Owen (1991). One live male *D. auriculatus*, the thorax and head only of another, and the elytra only of a third were found. The live male was released after photographing and measuring (see Appendix 1) and the fragments were lodged in the NZ Arthropod Collection, Mt Albert, Auckland.

The live male was found beneath a rotting tawari log in the rotting wood between the sound timber and the ground itself. The tawa (*Beilschmiedia tawa*)/tawari canopy had an understorey of kiekie (*Freycinetia baueriana* subsp. *banksii*), kanono (*Coprosma grandifolia*), supplejack (*Ripogonum scandens*), hangehange (*Geniostoma rupestre* var. *ligustrifolium*), tawa, and ferns *Asplenium* sp. and *Blechnum discolor*. The site (grid reference T13 517033) was 620 m above sea level, faced northwest, and had a slope of <10°.

The fragments of the two dead stag beetles were found beneath a rotting log which was dry on top but damp underneath. The forest canopy was tawa/tawari with scattered red and hard beech (*Nothofagus fusca* and *N. truncata* respectively). The understorey was pigeon wood (*Hedycarya arborea*), wheki (*Dicksonia squarrosa*), *Cyathea smithii* and mahoe (*Meliccytus ramiflorus*). The remaining vegetation cover closer to the ground included supplejack, kiekie, *Blechnum discolor*, hen and chicken fern (*Asplenium bulbiferum*), *A. oblongifolium*, mahoe, kanono, rice grass and hook grass (*Uncinia uncinata*).

The dead beetles were found at 640 m a.s.l. at a westerly aspect on ground sloping <5° at grid reference (NZMS 260 T13 535049). The site is on the Upper Mangakino Stream track near Lewis and Bartley Creeks.

### **3.6 Miscellaneous surveys of the Coromandel**

Six other surveys for *Dorcus* are known to have been carried out since 1983 by employees of the Department of Conservation (5) or by the NZ Wildlife Service (1) (for locations see Figure 1). The results of these surveys are summarised below. In 1983 Colin Johnson (a temporary employee of the NZ Wildlife Service's Coromandel frog

survey team) produced a handwritten report on his observations of *Dorcus* species which he made while surveying frogs. The report was never formally written up even to the extent of being placed on a Public Service file.

Six males and one female stag beetle were found at Moehau and five males at Hill 1092. Their measurements are recorded in Appendix 1. Johnson also obviously could not discern any difference between the beetles from the two localities since he referred to beetles from Mt Moehau as "*D. auriculatus*". In the Mt Moehau area Johnson located four males and one female in "open country" in the sub-alpine area at altitudes ranging between 760-840 m a.s.l. These were under "large bored out logs" which he surmised were kaikawaka. Three other males were found under rocks in a forested gully. Johnson also reported Mike Meads (then Ecology Division, DSIR) finding stag beetles at 460 m a.s.l. on the Moehau Range.

On Hill 1092, the beetles were all found in "climax forest" comprising tawa/rimu with northern rata (*Metrosideros robusta*) and kauri (*Agathis australis*) in an area approximately 0.5 km<sup>2</sup>, which was poorly drained with boggy soils. Four beetles were found under rotting hardwood logs and one under a stone at altitudes from 700-720 m a.s.l. The end of their distribution was thought to correspond with the end of the boggy soil (a thin lithosol over an andesite larva flow) just before the summit of the hill.

On 3 November 1988 Andy Garrick found a live male *D. auriculatus* (Dr Beverley Holloway [pers. comm. by letter](#) to Department of Conservation Hamilton 14 November 1988) in the Grace Darling Stream catchment of the Waitekauri River in the southern Coromandel Ranges (T13 549253). It was found under a partly decayed log about 500 m a.s.l. in matute forest comprised of tawari, kamahi, tawheowheo, pigeonwood and tawa. In the same region on 11 December 1991 Rick Thorpe found a live male *D. auriculatus* (Dr. Beverley Holloway pers. comm.) near Motutapere hill (T12 489511). This specimen was under a log on an exposed ridge with the surrounding forest predominantly *Dracophyllum pyramidale* and tawheowheo. Another male *D. auriculatus* was discovered by Rick Thorpe on 28 January 1992 further south about 7 km southeast from Manaia (T11 376748) at about 650 m a.s.l. The beetle was discovered under a log but no other details of its habitat are available.

Further south, near Te Aroha, Warren Geraghty (Conservation Officer, Te Aroha Field Station) reported Mr Ross Stewart (a Broadcasting Company of New Zealand employee servicing the Repeater station on Mt Te Aroha) who had collected a live male *D. auriculatus* on the road 1 km below the summit (T13 528043) on 14 February 1992. This specimen was passed on to K. Owen for identification and subsequently released back on the mountain where it was found.

Five male stag beetles (presumably *D. auriculatus*) were found from Thomson's search of the Mangakino ridge (see Appendix 4) on the 15 and 16 April 1992. One was on the western side of the ridge (527057) on a high knoll (780 m a.s.l.) under a log in tawari, tawheowheo and kamahi canopy (8 m high) forest with and understorey of tree fern, pigeonwood, toropapa (*Alseuosmia macrophylla*), hangehange, pate (*Schefflera digitata*), supplejack, mangemange (*Lygodium articulatum*), broadleaf and kanono. The

ground was covered with a moist dark humus or leaf litter. The other four were found approximately 300 m north of the first surrounding a knoll at the following heights and grid references: 620 m, 528068; 650 m, 526068; 630 m, 527069; 630 m, 527069. The forest in this area included a canopy of kanono, mahoe and horopito (*Pseudowintera colorata*) with a sparse understorey with rengarenga (*Arthropodium cirratum*) and hen and chicken fern. The ground was relatively dry but with a thick humus and leaf cover. Two beetles were found under rotting logs and one under a rock.

No stag beetles were found on the second survey in April 1993 (see Appendix 4).

### 3.7 Harihari-Saltwater – *Dorcus helmsi*

Four male stag beetles were found on the night of 25 January 1992 (for locations see Figure 2), but none the following day searching the same area (Appendix 4). The forest is exceptionally homogeneous with the dominant canopy species being rimu with some *Quintinia acutifolia* understorey. All the beetles were found "active" on tree trunks - 3 on rimu and one on a *Q. acutifolia*. Two beetles were found at 2 m, one at 3 m and one at 1 m above the ground. All the beetles were found crawling except for one that was feeding on the exudate from a rimu. This male was seen chewing through the bark to the cambium layer (as evidenced by the fresh look about the wound) apparently in order to suck or lap up the exudate. When the spotlight was shone on the beetles they immediately tried to seek shelter away from the light. Two of the beetles were found within 30 m of the road-end clearing edge where there is still a lot of rotting wood debris from clearing operations. The ground was very flat and poorly drained (altitude 24 m a.s.l.). The weather was calm and mild (temperature of 15°C).

No stag beetles were found on Mt Hercules or in the Poerua Scenic Reserve (Appendix 4) or on the escarpment bush south of the main road behind Harihari township. Night time observations in Saltwater State Forest from 2125 to 2400 (NZST) on 26 January revealed five male stag beetles, one of whom was in company with a female. These observations were made at approximately grid reference S63 028078. The weather was cloudy, with no wind or rain and mild temperatures (circa 17°C). On one rimu of 68 cm diameter at breast height (DBH) a male was found 3 m above the ground. This beetle was observed for 10 minutes chewing on bark-presumably trying to access the cambium layer underneath. Indirect or low wattage light did influence its behaviour. Since it was on the same tree as one found two nights previously, it is possible that it was the same beetle. When the bark under which it finally sheltered was investigated a female was discovered-presumably its partner. No other beetles were found on the tree. The second male was found 3 m above the ground on another rimu (75 cm DBH) about 2 m away. It was relatively mobile compared to others and moved about 50 cm in a few minutes before retreating under a flap of loose bark. A male was found immobile about 4.5 m above the ground on a rimu tree with a DBH of 65 cm. After a short period of exposure to the spotlight it moved away. The fourth male was walking on a rimu trunk (100 cm DBH) about 2.5 m above the ground and the fifth was found at ground height on a rimu (66 cm DBH) inactive. There was some epiphytic growth on the trees on which the last two beetles were found, but none evident on the others. The last beetle had noticeably smaller jaws and overall body size compared to the others.

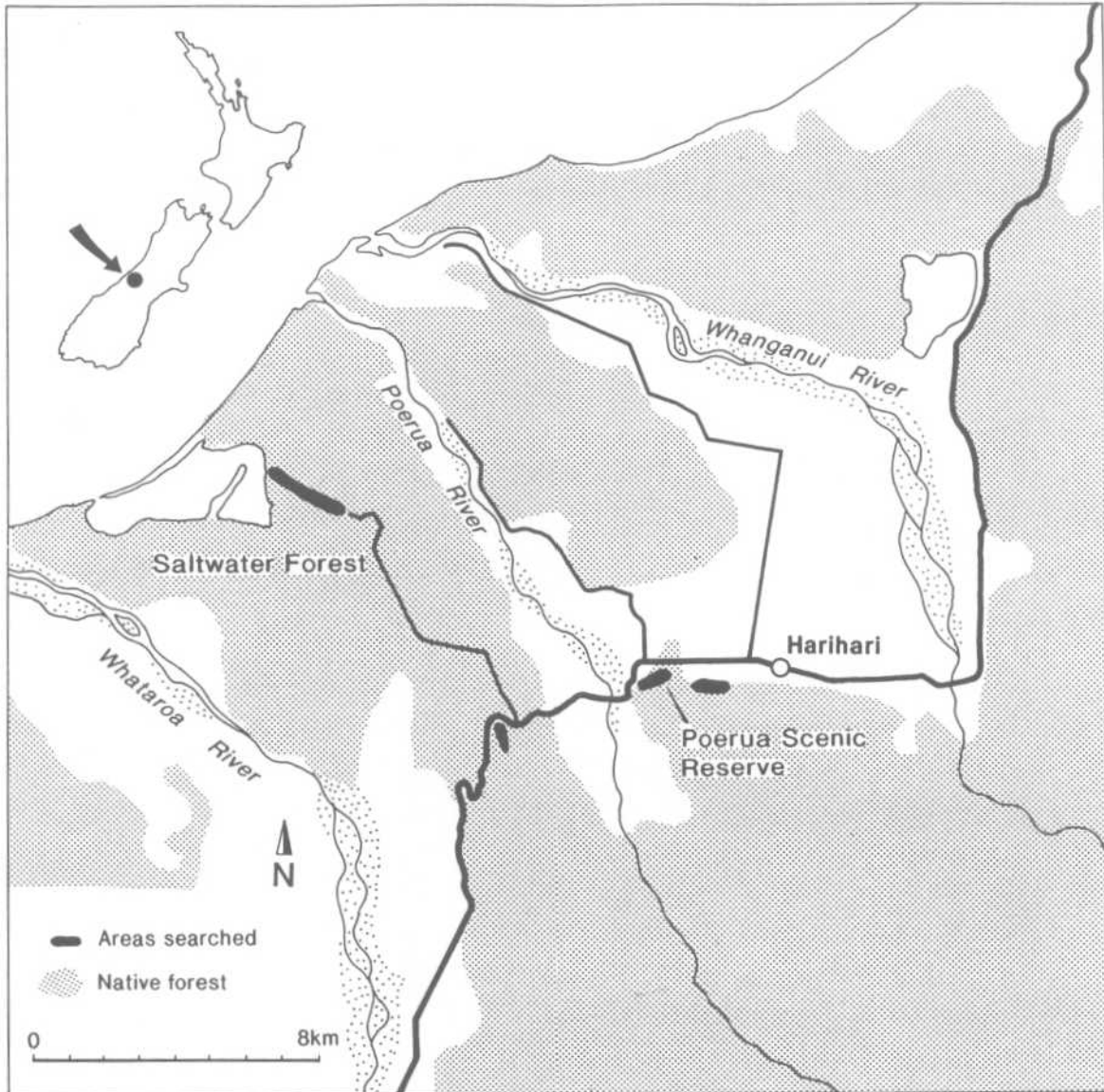


Figure 2 Locations searched for stag beetles near Harihari.

### 3.8 Chatham Islands

Rob Chappell (Coromandel Field Centre, Department of Conservation) showed the senior author a male *Dorcus* specimen collected from the Sisters islets in the Chatham Island group. When this specimen was forwarded to Dr Holloway (to be later lodged in the NZ Arthropod Collection), she identified it as a new species endemic to the Sisters which will be included in her revision of the Lucanids (Dr Beverly Holloway pers. comm.). Thus this species is distinct from the other Chatham Island Lucanid (*D. capito*) which is endemic to the main island (Chatham Island). Chappell (pers. comm.) describes the Sisters species as common.



#### 4. DISCUSSION

Day time searching under rotting, fallen timber compared with passive sampling such as pitfall trapping probably under-estimates the number of stag beetles present in the habitat. For example, no stag beetles were found on the ground at Saltwater State Forest during daytime searching but were frequently caught during pitfall trapping (Paddy Walsh pers. comm.). It was possible that stag beetles at Saltwater State Forest sheltered by day under bark on standing timber because no stag beetles were found under fallen dead timber. Thus stag beetles caught in pitfall traps at Saltwater may have been only moving between trees. Also survey effort may not have been targeted in areas which reflected habitat preferences which remain unknown for all species of *Dorcus*. For example, Paddy Walsh (pers. comm.) working at Saltwater State Forest noted higher numbers of stag beetles caught in pitfall traps from areas with a northerly aspect and with large growth rimu forest.

There may be a relationship between the volume of dead timber (fallen or standing) which in turn relates to the age of the forest and the abundance of stag beetles. The forest inland from Coromandel township northwards almost to Moehau was notable for the absence of dead timber and its apparently young age. These characteristics correlated with an absence of stag beetles and very few beetles of any sort. Most of these areas have been repeatedly logged, burnt and cleared in the past for timber extraction and prospecting for mining (Rob Chappell pers. comm.). With these land use practices the natural distribution of insect species was probably destroyed. However, further survey is required to determine the extent and distribution of *D. auriculatus* and the new species on Moehau. In the latter's case it would be desirable to learn the southern limit of its distribution, especially as far down the main range as far as the trig labelled "BA" on T10 and U1.0 at grid reference 312977.

Future surveying would probably be more efficiently achieved by using pitfall traps in clusters of 20-50 at strategic points in mature forest along the Coromandel Range from Karangahake Gorge to the "BA" trig. The effectiveness of the pitfall traps could be extended by placing barricades which radiate from the trap so that wandering beetles encountering the barricade walk along it until they reach the trap.

*D. ithaginis* appears to be restricted to Stack H in the Mokohinau Islands as all other likely habitats in the group have been searched, except Fanal which still has kiore. The type specimen however, was most likely to have been collected from Lizard Island (Dr Beverley Holloway pers. comm.) over a century ago (Holloway 1961) but no specimens, or even fragments, were found on this island despite detailed searching on each of the three trips. During May 1977 an ornithologist camped on Lizard for several nights and reported no sign of rats. However, a visit by Dr Willy Kuschel to Lizard Island during February-March 1978 found rats (presumably kiore) present but no sign of the stag beetle. Subsequently, during 1978, poison bait was laid on the island to eradicate the rats (Wildlife Service File 35/2/5 and Dick Veitch pers. comm.). Therefore it appears that kiore may have been present on Lizard for only a limited period, probably less than 18 months.

Despite the fact that information on the distribution of some species is still incomplete, it is possible to make some qualified statements about the conservation status of the *Dorcus* species in New Zealand. Because *D. ithaginis* is restricted to Stack H it should be categorised as endangered (*sensu* IUCN definitions in Williams and Given 1981) mainly on the grounds of its extremely limited distribution (one only rock stack with a vegetated area of less than 100 m) and a correspondingly small and vulnerable population size. While the population cannot be shown to be declining, any one of a number of environmental perturbations could cause extinction very quickly, e.g., rat invasion, fire or even erosion from excessively heavy seas. *D. ithaginis* has been similarly categorised by others. For example Bell (1986) considered it endangered and Molloy and Davis (1992) ranked it amongst their "Category A" species - a "highest priority threatened species" (threatened *sensu* IUCN definition). These and the present assessment justify the top rank of "1+" given by Sherley (1989) as an important species for management and research.

Collections from this study have established that the stag beetle found on Mt Moehau is a new species. Although it is too soon to assume that *D. "Moehau"* (Figure 3) is restricted to the Mt Moehau vicinity, it seems likely that it has a restricted distribution and is compromised by the usual range of threats, e.g., introduced predators and habitat modification. However, there is no evidence from this study that this species is declining. *D. "Moehau"* was found in larger numbers for the amount of time spent searching compared to *D. auriculatus*, but could be reasonably categorised at least as "rare" in terms of IUCN definitions. This species was listed by Molloy and Davis (1992) in "Category A", but it was unknown to Sherley (1989) and Bell (1986) or to Johnson (1983 unpub.). It is uncertain if Molloy and Davis's (1992) ranking for the species would change given the new information from this study.

*D. auriculatus* has been categorised by Bell (1986) and Molloy and Davis (1992) as endangered and a "Category A" species respectively, while Sherley (1989) ranked the species as "1" for requiring further research. Given that this study has significantly extended its northern range from its previously only known locality (Mt Te Aroha), it would seem reasonable to reduce the conservation status of this species from "endangered" to "rare" in IUCN terms. The stag beetles reported in Johnson (1983 unpub) almost certainly were the new species from Mt Moehau and *D. auriculatus* from "Hill 1092" inland from Te Puru. His drawings of male genitalia of a stag beetle collected from the Te Puru area were those of *D. auriculatus* (Holloway pers. comm.).

Some tentative generalisations can be drawn on the natural history of *Dorcus* species. There may be some preference of Coromandel stag beetles for higher altitudes given that most of the observations reported there occur over 450 m a.s.l. However, this may simply be a consequence of the least modified habitat occurring at these altitudes, and most of the search effort has been in habitat at high altitude. *D. helmsi* may be found from sea level to alpine altitudes (pers. obs.), so it is obvious that at least one species in the genus is highly flexible in the type of habitat it can occupy. This is supported by *D. ithaginis* and the new *Dorcus* species on the Sisters islets in the Chathams Islands group which exist at, or near, sea level.

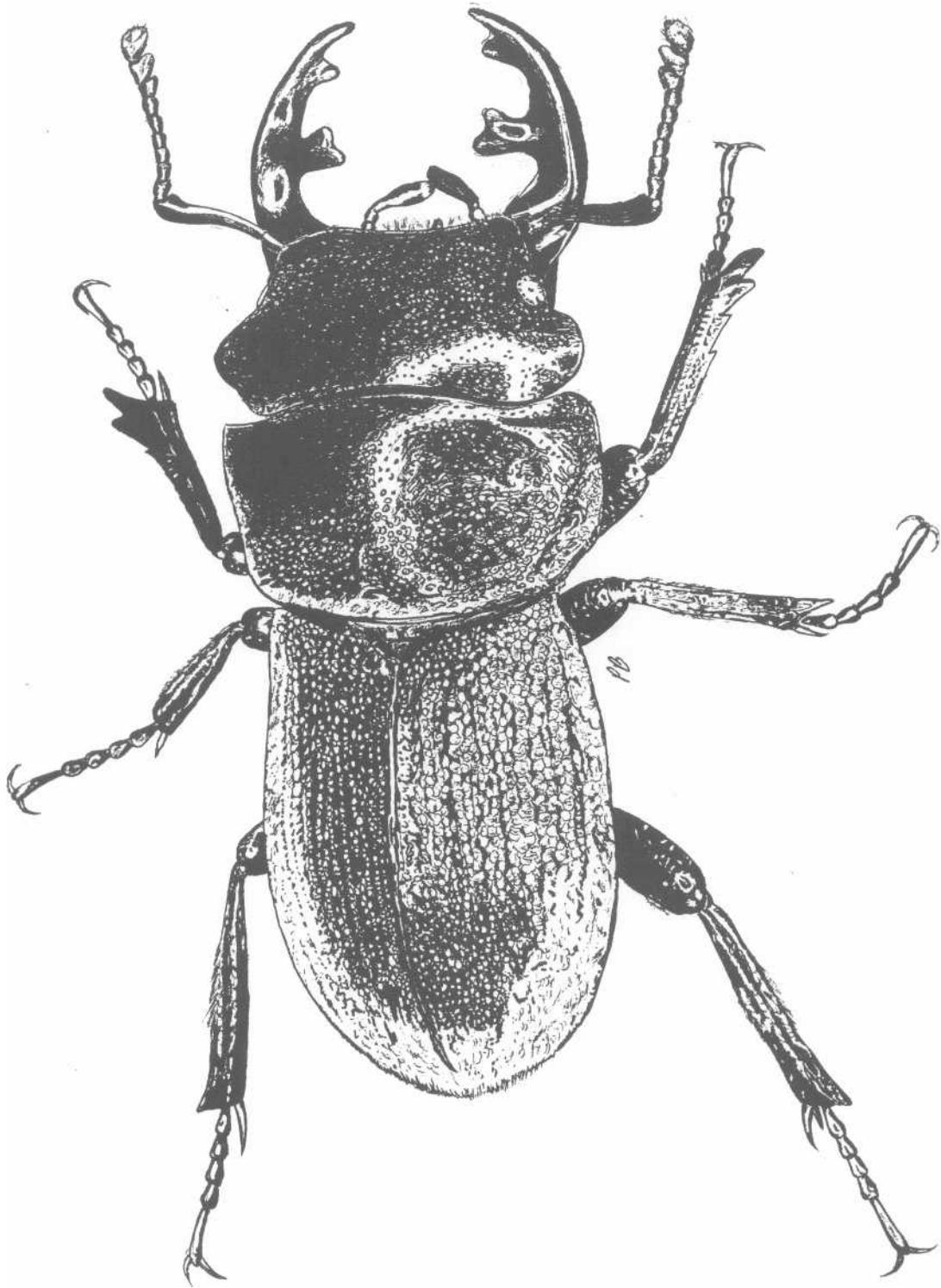


Figure 3 Illustration of a male *Dorcus* "Mochau". Life size length is about 25 mm.

The feeding ecology of stag beetle larvae may also be variable. The larvae found on Mt Moehau were almost certainly feeding on the decaying wood and/or associated fungi on the logs under which they were found. This could explain the dark grey masses that could be seen through their translucent skin. These could have resulted from eating the dark red-brown decaying wood. However, there is very little decaying wood on Stack H in the Mokohinau Islands and none whatsoever on the Sisters in the Chathams group. Stag beetle larvae in these situations obviously must rely on another food source - perhaps feeding on roots although this is not reported by Lawrence and Britton (1991) as occurring in other Australasian Lucanid larvae. For similar reasons the feeding ecology of adult stag beetles must be variable according to their habitat. The sap feeding behaviour observed in *D. helmsi* is unlikely to occur with stag beetles living on the Sisters (with little or no woody vegetation) or with *D. helmsi* living in the tussock zone in the South Island high country.

Obviously the behavioural ecology of *Dorcus* stag beetles is highly variable - even within the same species (e.g., *D. helmsi*). Therefore, the idea of using "analogue" studies to elucidate features of the natural history of *D. ithaginis* in lieu of working on *D. ithaginis* itself would be of limited value. Such studies should be done (if at all) with extreme caution, and done knowing precisely what questions are being addressed and why. Research concentrating on the one Stack H population may compromise the population because of the fragility of the island. Yet there is no doubt that some research is needed before intelligent management decisions can be made to secure the species against extinction. A compromise may be to begin preliminary analogue research on the Sisters species because, of all the *Dorcus* species, its habitat is the most similar to that of *D. ithaginis*. As well, or alternatively, a study could be started on *D. helmsi* on the west coast of Five Fingers Peninsula, Resolution Island where it is common during the day in grassland (*Poa astonii*) habitat (B. Patrick pers. comm.).

As there is only one small and extremely vulnerable population of *D. ithaginis*, the first management task should be to secure the species against the risk of extinction. One option is to translocate stag beetles (from the wild or captive-bred stock) to start a founder population(s). For example, Lizard Island could be a suitable site to establish a second population since *D. ithaginis* have apparently been recorded from there in historical times. Future research should focus not only on the population size on Stack H, but also on recognising the species' habitat requirements at the different stages of the life cycle.

#### **4.1 Recommendations**

1. Further surveys for *D. "Moehau"* and *D. auriculatus* in the mature forest areas of the Coromandel and Kaimai Ranges using pitfall traps, and documentation of all aspects of their natural history that is possible.
2. Further searches of Stack H at night in the dark phase of the lunar cycle (to maximise the chances of finding them if they are photophobic) to determine the population size and elucidate as much as possible about the habitat requirements and life history of *D. ithaginis*.

3. Survey of the north west islets of the Hen and Chicken group to ensure that *D. ithaginis* is indeed restricted to Stack H in the Mokohinau Islands.

After a year of further survey data collection, another review of research requirements should be made.

## **5. ACKNOWLEDGEMENTS**

Our thanks to Murray Thompson and Rob Chappell for allowing us to use information from their field reports and to Paddy Walsh for discussions and hospitality at Harihari. Willy Shaw, Murray Thompson, Phil Thomson, Rick Thorpe, Liz Humphreys, Rob Chappell, Terry Greene, Ian McFadden, Duncan Emerson and other Department of Conservation field staff helped in the survey. Beverley Holloway identified specimens and provided advice on how and where to find stag beetles. Andrew Jeffs and Brian Patrick improved the text and Chris Edkins drew the figures. Finally, a special thanks to Paul Barrett (Wellington Zoological Gardens) for drawing the sketch of the Moehau stag beetle.

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APPENDIX 1

Morphometrics of *Dorcus* stag beetles (dimensions in mm)

GRID	REFERENCE <sup>1</sup>	SEX	LOAH <sup>2</sup>	LOA <sup>3</sup>	Mandible <sup>4</sup>	HW <sup>5</sup>	HL <sup>6</sup>	PNL <sup>7</sup>	PNW <sup>8</sup>	ELYL <sup>9</sup>	ELYW <sup>10</sup>
1. MT. MOEHAU ( <i>D. "Mochau"</i> )											
S10	254159	♂	–	–	6.40	9.14	–	5.42	9.98	11.16	8.86
S10	254159	♀	–	–	3.02	6.10	–	6.12	9.92	12.72	9.72
S10	260148	♂	–	–	7.12	9.94	–	5.48	10.48	12.30	9.36
S10	260148	♀	–	–	2.96	6.30	–	6.20	10.22	13.10	10.02
S10	248157	♀	–	–	2.66	5.56	–	5.32	9.08	11.96	8.70
No	data	♂	–	20.55	4.25	–	–	–	8.20	10.35	7.55
"	"	♀	–	21.35	2.65	–	–	–	9.15	11.90	9.00
"	"	♀	–	15.70	1.65	–	–	–	7.15	8.60	7.35
"	"	♂	–	25.45	6.00	–	–	4.80	9.80	11.85	9.05
"	"	♂	–	24.30	5.60	–	–	5.20	9.70	11.25	9.00
"	"	♂	–	21.30	4.35	–	–	4.60	8.35	10.45	8.15
"	"	♂	–	20.00	4.10	–	–	4.40	8.30	9.90	7.45
2. COROMANDEL PENINSULA EXCLUDING MT. MOEHAU ( <i>D. auriculatus</i> )											
T10	395599	♂	–	24.30	5.85	–	–	5.55	10.40	10.30	9.25
T10	395599	♂	–	21.95	4.50	–	–	5.80	9.80	10.35	8.75
T10	395599	♂	–	21.00	4.30	–	–	5.35	9.25	9.60	8.50
T10	395599	♂	–	22.45	4.50	–	–	5.25	9.85	10.10	8.90
T10	395599	♂	–	20.10	4.40	–	–	4.85	8.85	9.50	8.10
T10	395599	♂	–	22.75	4.80	–	–	5.45	9.65	9.80	8.95
T10	395599	♂	–	25.40	6.30	–	–	5.70	11.00	11.10	9.85
T11	376748	♂	–	–	7.92	11.72	–	5.80	11.90	11.50	10.18
T12	489511	♂	–	–	8.12	12.28	–	6.18	12.90	11.94	10.74
T12	397599	♂	–	–	–	11.22	–	–	–	11.88	10.52
T12	394597	♂	–	–	6.08	9.54	–	5.56	10.40	10.44	9.34
T12	394597	♀	–	–	4.88	8.86	–	4.58	9.78	10.34	8.54
T13	517033	♂	21.10	24.65	6.20	–	5.70	5.55	11.60	10.45	9.75
T13	535049	♂	–	–	5.10	–	5.50	6.20	10.10	10.40	8.50
T13	528043	♂	19.45	24.65	7.50	–	6.00	5.05	10.90	10.30	8.90
T13	527057	♂	19.50	23.00	5.00	9.20	5.00	5.10	10.00	10.50	9.00



GRID	REFERENCE <sup>1</sup>	SEX	LOAH <sup>2</sup>	LOA <sup>3</sup>	Mandible <sup>4</sup>	HW <sup>5</sup>	HL <sup>6</sup>	PNL <sup>7</sup>	PNW <sup>8</sup>	ELYL <sup>9</sup>	ELYW <sup>10</sup>
3. Johnson's (1983) data.											
A. MT. MOEHAU ( <i>D. "Moehau"</i> )											
No	data	♂	22.0	27.0	-	-	-	-	10.5	-	-
"	"	♀	19.0	21.0	-	-	-	-	9.0	-	-
"	"	♂	23.0	27.0	-	10.5	-	-	11.0	-	10.0
"	"	♂	20.0	24.0	-	9.0	-	-	9.0	-	8.5
"	"	♂	20.5	24.0	-	9.5	-	-	10.0	-	9.0
"	"	♂	20.0	23.5	-	8.0	-	-	8.5	-	8.0
B. THAMES ( <i>D. auriculatus</i> )											
No	data	♂	19.5	23.0	-	9.5	-	-	10.0	-	9.0
"	"	♂	19.5	23.0	-	10.5	-	-	10.5	-	10.0
"	"	♂	21.0	25.0	-	10.5	-	-	11.0	-	9.5
"	"	♂	21.5	26.0	-	11.0	-	-	11.5	-	10.0
"	"	♂	19.0	22.0	-	9.0	-	-	9.5	-	9.0
4. STACK "H" (MOKOHINAU ISLANDS) ( <i>D. ithaginis</i> ) <sup>10</sup>											
No	data	No data	No data	No data	3.50 <sup>11</sup>	7.88	4.22	6.72	10.54	10.18	10.46
					3.26 <sup>11</sup>	6.76	4.14	4.96	9.14	10.78	10.46
					3.84 <sup>11</sup>	7.70	4.32			8.40	8.50
					3.02 <sup>11</sup>	5.64	3.24			9.36	8.86

- NZ mapping series 260 (metric) sheet number and six figure grid reference (eastings, northings)

<sup>2</sup> - maximum body length not including jaws

- body length with jaws closed

<sup>4</sup> - mandible length: tangent between distal tip and ventral articulation point

- maximum head width

<sup>6</sup> - head length from sutures along dorsal mid-line to mid-point between mandibles

- maximum distance between abdomen and head sutures measured dorsally

<sup>8</sup> - maximum pronotum width

<sup>9</sup> - length of elytra measured dorsally from distal edge to mid-point of abdomen/pronotum suture

<sup>10</sup> - measurements from fragments only

- female jaw lengths, head measurements from same fragments

## APPENDIX 2

### A description of "Stack H" stag beetle habitat, Mokohinau Islands

Stack H is a steep sided dome-shaped stack, approximately one hectare in area, 40 m at its highest point, with about two thirds covered in some form of vegetation. There are large "beds" of ice plant (*Disphyma australe*) and glasswort (*Sarcocornia quinqueflora subsp. quinqueflora*). Smaller areas of pohuehue (*Muehlenbeckia complexa*), flax (*Phormium tenax*), taupata (*Coprosma repens*) and wharangi (*Melicope temata*) occur in patches. A small area of low coastal forest is present at the northern end of the island containing pohutukawa (*Metrosideros excelsa*), *Melicytus (Hymenanthera) novaezealandiae*, karo (*Pittosporum crassifolium*) and houpara (*Pseudopanax lessonii*). The canopy height of this forest was approximately two to three metres with a good build-up of litter and soil beneath. The eastern side of the island is more sheltered and is stepped. As a result, this side has more vegetation and a greater build up of litter and humus. The exposed western side and northern end of the stack were largely bare rock sloping to the sea.

## APPENDIX 3

### IUCN definitions of species rarity used in assessing the Conservation Status of *Dorcus* stag beetles

- Endangered** – "species in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included are species whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction. This is interpreted to mean including species with populations so critically low that a breeding collapse due to lack of genetic diversity becomes a possibility, whether or not they are threatened by man."
- Vulnerable** – (equates to threatened in Bell 1986) "Species believed likely to move into the endangered category in the near future if the causal factors continue operating. Included are species of which most or all of the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance; species with populations that have been seriously depleted and whose ultimate security is not yet assured; and species with populations that are still abundant but are under threat from serious adverse factors throughout their range."
- Rare** – "species with small world populations that are not at present endangered or vulnerable but are at risk. These species are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range."

## APPENDIX 4

### Details of search effort, dates and locations recorded searching for stag beetles

#### 1. Mokohinau Islands

Three survey trips to the Mokohinau Islands have been carried out by the authors and three others (see acknowledgements). The first trip occurred in June 1991 for two weeks, the second in April 1993 for one week and the third for one week in November 1993.

Only two visits to Stack "H" were made on the same day on the 1991 field trip: a four hour visit in the morning and an hour long visit by four people at night. Other islands in the Mokohinau Island group were visited during June 1991 and searched for stag beetles though with varying amounts of effort which was dictated by weather conditions at the time. Maori Bay, Trig, Lizard and Burgess Islands were searched but no stag beetles were found. However, Maori Bay and Trig Islands were visited only once each and very briefly. Lizard Island was visited three times and searched for about four person-hours by up to four people during the late morning and early evening.

On the April 1993 trip Stack "H" was visited three times in the evening over six days. About 4.5 hours were spent searching in fine weather and bright night time conditions (near full moon) and dry litter conditions. On 1 April the Stack was searched between 2015 and 2115 hours, when the single female was found, on 4 April between 2100 and 2230, and on 5 April between 1845 and 2045.

Lizard Island was visited in the late morning on 4 April 1993 and searched for a total of 1.5 person hours. Other islands and stacks searched included: on 5 April, Stack "B" for two person hours between 0815 and 0915; Stack "F" for one hour between 1400 and 1500 by Green; Stack "G" for two person hours between 1400 and 1500 by Ian McFadden and Terry Greene; "Flax" Island for 1.5 person hours by three people between 1515 and 1545; and on 6 April, groper Rock for a total of 16 person hours, including between 1300 and 1400 by Green, McFadden and Greene, then the remaining 13 hours at various intervals during that night. No sign, either fragments or whole beetles, of *D. ithaginis* was found on any of these other islands.

During the November 1993 trip a total of 13.5 person hours was spent searching Stack "H" at night and 4 person hours during the day. On 11 November Sherley and Green searched between 1000 to 1200, then at night, together with Peter de Lange between 2045 and 2315. On 12 November the island was visited between 1130 and 1330 to take measurements and describe the habitat, then at night Sherley and Green searched between 2115 and 2315, then on 13 November both searched between 2100 and 2200 hours. Weather conditions were generally clear, mild to cool with a light to moderate SW breeze and no moon. No live *D. ithaginis* were found during the trip.

Other islands searched during the November 1993 trip included Lizard Island between 2315 to 0015 for two person hours by Sherley and Green on 9 November and Stack "D", which was known to have had kiore prior to 1990 (Ian McFadden pers. comm.), was searched for 0.5 hour late one afternoon with little sign of invertebrate activity on the ground. Also, the very small area of iceplant and glasswort on Sphinx Rocks was searched for approximately 0.25 hours with the coastal earwig (*Anisolabis littorea*) being the only large invertebrate found.

#### 2. Mt Moehau

At least five people systematically searched all altitudes above the bush line between the summits of Mt Moehau (S10 250159) and Little Moehau (S10 260148) between 6 January to 8 January 1992 inclusive. Mt Moehau and Little Moehau lie within the Colville Ecological District of the Coromandel Ecological Region (McEwen 1987). Both summits have sub-alpine vegetation which is wind-shorn and stunted and the soils are continually wet and boggy. About 120 hours in total were spent searching although no formal record of the number of hours was kept. A night time search was also carried out on Monday 6 January 1992 for three hours from 2200 hours (NZ standard time).

### **3. Coromandel**

Searches were made between 12 and 14 January 1993 in about 24 person-hours searching. The Castle Rock area was searched by two people from grid reference T11 390850 to 391855. The forest to within 20 m off the road verge along Hodder East Road was also searched from the start of the Castle Rock track (grid reference T11 390850) to a point at grid reference T11 380874. From here a search was made of the catchment of the stream that crosses the road (i.e., runs roughly south of the hill which has a spot height of 573 m a.s.l. on the map) by walking upstream in a loop which included both sides of the stream. A search (seven person-hours searching) was made of the public walking track marked to the "Kauri Grove" about 1 km after Waiiau Falls on No. 309 Road which leaves State Highway 25 about 5 km south of Coromandel at grid reference T11 381814. On 13 January 1993 a search from the summit of "Route 25" (State Highway 25) at grid reference T10+U10 370916 north along the main dividing ridge track to Kaipawa trig (T10+T11 360929) and then to the radio-mast trig (T10+T11 355942) and out to the Kennedy Bay Road took nine person-hours search effort.

Three and half person-hours were spent searching on 14 January 1993 from T10+T11 370916 to 372901 but the forest in this area had been repeatedly burnt, partially cleared and some of the land has eroded. The same was true of the forest north along the main dividing ridge between the summit of Kennedy Bay Road (T10+T11 370916), the "BD" trig at 344991, the HI trig at 348010 to the point 343013. Two excursions off this route were made concentrating on habitat about 200 m either side of points 332985, 347005 and 329979. These searches were made over six person-hours.

### **4. Miscellaneous surveys of the Coromandel area**

During Johnson's survey two areas were searched: the environs of Mt Moehau (NZMS 260 S10 255151) and "Hill 1092" (T12 395599) east of Te Puru (the latter is a trig station labelled on the map as "1092"). Johnson wrote that he had searched only under logs and stones in the course of looking for frogs and therefore other possible habitats such as standing trees, were not investigated. No dates for the survey were given but it is thought that the survey was carried out during the summer of 1982/83 (Don Newman pers. comm.).

In April 1992 and April 1993 Murray Thomson conducted surveys for *D. auriculatus* in the Kaimai Mamaku Forest Park centred on Mt Te Aroha. His aim was to extend the April 1991 survey reported above. In 1992 five people searched 20-30 m either side of five cut tracks - four of which radiated along the various ridges from Mt Te Aroha Hut (T13 545052). These tracks (all marked on sheet T13 Paeroa) were searched for about 1 km from the but to points corresponding to grid references 537044, 549043, 553051 and 543062. The fifth track searched started from the Mangakino Tui mine track junction (526054) along the main Mangakino ridge (west of Mangakino Stream) adjacent to the park boundary and finished at a point approximately corresponding to grid reference 529070.

Murray Thompson's second survey from 13 to 15 April 1993 involved 5 people. They searched under all logs and stones they followed about 5 km of the Mangakino Ridge (between points on T13 529069 to 520120) which is part of the main ridge system of the Kaimai Range which continues northwards from Mt Te Aroha to Mt Karangahake.

### **5. Harihari-Saltwater**

On 25 January 1992 a night time search was conducted in the Saltwater State Forest for three hours from 1945 hours (NZST) along the track to Saltwater Lagoon from the road end at grid reference (NZMS 1 Okarito) S63 030076 to the first stream crossing at grid reference S63 026080. On 26 January logs and standing dead timber and loose bark were searched in a 2.5 hour day walk from the above road end at S63 030076 to Saltwater Lagoon. The search included the actual trees and surrounds where stag beetles were found the previous night.

A 1.5 hour night time search on 26 January started at 2130 hours (NZST) up the Mt Hercules TV Translator track (begins at grid reference S63 079003). The composition of the forest is variable but mainly dominated by kamahi with patches of rimu dominant on exposed shoulders. The search included

a climb of 183 m starting at 152 m a.s.l. On that night there was no wind, mild temperatures (about 17°C) and clear conditions.

A daytime search for 1.5 hours on 28 January 1992 was made in Poerua Scenic Reserve from a point opposite Oneone Road (grid reference S64 123028) between the main road and the stream in an easterly direction to the edge of the bush. The bush on the escarpment south of the main road behind Harihari township up to 300 m from its edge was searched from a point opposite Prefontaine's Bridge (grid reference S64 142026) due east to a point approximately opposite Wanganui Road (grid reference S64 156023). Two people searched for three hours in dry bush compared to the lowland forest of Saltwater State Forest searched on 25 and 26 January 1992.