

## Notes On *Agrotis innominata* Hudson (Lepidoptera: Noctuidae)

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### ABSTRACT

The endemic noctuid moth *Agrotis innominata* is recorded from several new southern coastal localities. The larvae are recorded as feeding on the exotic marram grass (*Ammophila arenaria*) in sand dunes. A description of the larva is given and comments are made on its native hosts. Southern populations (south of Westport and Christchurch) of the species are found to have a brachypterous female in contrast to northern populations. The flight period is found to be trans-winter (i.e. May-December). It is compared with coastal noctuid species in the Northern Hemisphere. The implications for *A. innominata* of the removal of marram grass and replacement with native species on dune systems is discussed.

**Keywords:** Noctuidae, *Agrotis innominata*, *Ammophila arenaria*, sand dunes, flight period, brachypterous female, conservation.

### INTRODUCTION

*Agrotis innominata* Hudson (Noctuidae: Noctuinae) (Fig. 1) is the only endemic species of the genus found in New Zealand. It was recorded from just 6 localities by Hudson (1928, 1939). These include the type locality at Wellington (possibly Titahi Bay) and Wanganui, Napier, Paekakariki, Milford Sound and Dunedin between May and December. Philpott (1917), who collected widely in Otago and Southland, noted only 1 southern locality, on sand dunes near St Clair, Dunedin, where it was found in abundance by C. C. Fenwick. It was assumed therefore to be a very localised species although common where and when encountered. The female of the southern populations was unknown. The biology of the species was also unknown, although C. C. Fenwick's observation that the species was plentiful on sand dunes (Philpott 1917) does give some clue to its ecology. Specimens in the New Zealand Arthropod Collection (NZAC) (DSIR, Plant Protection, Auckland) are from Auckland, Tauranga, Taupo, Tolaga Bay, Paiaka and Westport (J. Dugdale pers. comm.).

Prior to this study, adult males had been collected by B. H. Patrick from Haast, Kaitorete Spit and Portobello while N. Hudson (pers. comm.) found it at Cannibal Bay, Catlins in 1986. A possibly undescribed species close to *A. innominata* exists in coastal sand dunes on the southern Southland coast and on Stewart Island (Mason Bay). It was found in 1986-88 by B. H. Patrick (Patrick *et al.* 1989). The male forewings are shorter than those of *A. innominata* and the colour pattern is less distinct and more variable. The female of this possibly undescribed species has not been found among a long series of males attracted to light. All the males were captured between July and November. B. H. Patrick has collected noctuid species from a large number of southern New Zealand coastal sites over the past 10 years, so the paucity of records of this species is indicative of its localised status.

This short-term study began with the finding by K. J. Green of noctuid pupae in loose sand at the base of the introduced marram grass (*Ammophila arenaria*) in sand dunes at St Clair, Dunedin in May 1988.

### METHODS

Since then B. H. Patrick has searched successfully for larvae at both Kaitorete and

Fortrose Spits with the object of determining the larval foodplant(s) in sand dune systems which have large assemblages of native coastal plant species. Larvae located at St Clair were observed over the summer months. Further light trapping has been carried out at various sites in eastern Otago to check the presence or absence of the species at those sites.

## RESULTS

At St Clair, up to 10 pupae of *A. innominata* were found per marram plant, lying loose in the dry sand about 5 cm below the surface and always on the sheltered, in this case eastern, side of the plant. They are loose because the pupal cell, constructed by the larvae, disintegrates soon after pupation. A large percentage of the pupae were ready to hatch, with some doing so within the first 2 days of being placed in captivity. Moths continued to emerge over the months of June, July and August. Prior to emergence the pupa became quite shrunken about its wing cases, legs and head regions and could appear to be dead except for the movement of the abdominal segments.

The female moths were found to be brachypterous in contrast to the strongly flying males.

The larva (Fig. 2) grows to about 32 mm long and is a firm caterpillar of a grey-brown appearance. The prolegs are very short and the ventral surface very flat. Short pale hairs occur over the dorsal region of the larvae. The lateral surface is very wrinkled and broadly white in colour. Dorsally the larva has a double grey line and a darker grey sub-dorsal band. The ground colour is pale grey and brown. The ventral region is a uniform dull brown-grey. The larvae were adept at burrowing in sand but did not bury themselves very deep as most larvae were found 1-5 cm below the surface. At St Clair marram grass is considered to be the current foodplant because plants had signs of old feeding damage and no other plant was present within 5 m of its pupae. Also larvae of *A. innominata* found over the summer months were hiding in sand at the bases of the marram grass. Feeding damage on the marram indicates that they chew the stems and leaves of the plant. It is probable that feeding takes place at night as larvae were hiding in the sand in the daytime. Larvae found at Kaitorete Spit were in the foredune and appeared to be feeding on *Craspedia* sp. and sea-shore convolvulus (*Calystegia soldanella*). At Fortrose Spit both *C. soldanella* and *Acaena novaezelandiae* were eaten. The larva is therefore polyphagous but with certain preferred host plants. Observations at St Clair indicate that the larvae form cocoons in the sand and pupate from late February onwards, with a high proportion having pupated by 10 March.

Fresh feeding damage and larvae of another noctuid moth, *Tmetolophota phaula* (Meyrick), apparently confined to coastal sites, were located at the same time. Its larvae have been found previously on the native grass *Poa cita* (Hudson 1928). On the Dunedin coast, marram grass was found to be the host of a third, more widespread, noctuid species, the southern armyworm (*Persectania aversa* (Walker)) which is known from both inland and coastal sites feeding on various exotic grasses and gramineous crops (Ferro 1976). Its native food plant(s) are unknown.

Another exclusively coastal noctuid species in New Zealand is *Ectopatria aspera* (Walker) with larvae recorded from the salt-marsh plant *Sarcocornia quinqueflora* (J. S. Dugdale pers. comm.).

*Ectopatria aspera*, *T. phaula* and *A. innominata* appear to be the only noctuid species confined to the coast in New Zealand.

## DISCUSSION

*Agrotis innominata* has 3 characteristics that are unusual in New Zealand noctuids—coastal occurrence, female brachyptery and emergence pattern.

### Coastal Occurrence

*Agrotis innominata* is almost exclusively coastal. Out of the 174 species of Noctuidae known in New Zealand (Dugdale 1988) only 3 appear to be confined to the coast. A similar situation occurs in Canada at Beringia (Bering Strait area) where Lafontaine & Wood



(1988) found only 2 coastal noctuid species, both noctuines like *A. innominata*, out of a fauna of 245 species. Lafontaine and Wood considered that this low number of species breeding only on the coast may indicate that the dunes are important relics of a formerly important biotope in Beringia. Similarly Hardwick (1970) listed 2 species in the genus *Euxoa* that exclusively breed in dune systems of the western United States. Common (1957) in a review of the genus *Agrotis* in Australia found 2 species to be restricted to "coastal and subcoastal districts". Zimmerman (1958) listed 27 species of the genus *Agrotis* from the Hawaiian Islands, of which 26 species are endemic to Hawaii. He noted that 3 species were confined to coastal areas including sand dunes. One of these species, *A. arenivolans*, has a striking resemblance to *A. innominata*. Another species, *A. photophila*, was noted by Zimmerman as being possibly exterminated as no specimens had been recently collected. For eastern North America, Covell (1984) listed 45 species in the sub-family Noctuinae of which 2 species, both in the genus *Euxoa* were known to be confined to coastal sand dunes. One of these species was recorded as polyphagous on both native coastal plants and introduced gramineous species. Oddly, both *Euxoa* species emerge as adults in the same calendar months (August-October) that *A. innominata* adults are at peak abundance in New Zealand, which means that *Euxoa* emerges in autumn in the Northern Hemisphere but *Agrotis* in spring in the Southern Hemisphere.

### Female Brachyptery

Female *A. innominata* are brachypterous in southern populations (Fig. 1) and are therefore relatively immobile and confined to small areas. Evidently the transition from native coastal communities dominated by pingao (*Desmoschoenus spiralis*) and *Austrofestuca littoralis* to mainly exotic communities dominated by the abundant marram grass has been such that species like *A. innominata* have been able to survive despite having a relatively immobile female. Our observations suggest that the species is usually only present in the older back dunes in its coastal localities suggesting that it has not yet been able to expand its range onto the newly formed fore dunes. Local extinction though, cannot be ruled out as a factor in the local occurrence of the species. Barratt & Patrick (1987) reported 1 other New Zealand noctuid (*Ichneutica ceraunias*) having brachypterous females in at least 1 population, but it is not known what percentage of the female sub-population is brachypterous.

### Emergence Pattern

*Agrotis innominata* displays an emergence pattern that is effectively trans-winter. Adults are known to emerge first in May (late autumn) and adults continue to emerge in small numbers throughout the winter months, although the largest numbers emerge from August to December. This pattern of emergence is known in another New Zealand noctuid species, *Meterana vitiosa* (Butler) of forest and shrubland areas (B. H. Patrick unpublished data). As both experience quite different climatic and ecological regimes the resemblance may well be coincidental. K. J. Green (unpublished data) observed that the large coastal scarab beetle *Pericoptus truncatus* began emerging as an adult in May on the Dunedin coast and continued to emerge in small numbers throughout the winter months but with peak emergence in August-October showing that this type of emergence pattern is not limited to moth species.

### Host Plants

It is possible that the endemic sea-shore convolvulus is the main original host of *A. innominata* as the distribution of that plant species (Allan 1961) matches reasonably closely the known distribution of *A. innominata*, including its only inland occurrence at Taupo.

Marram grass was originally planted on New Zealand dune systems to promote stability (Cockayne 1911) but nowadays it is generally regarded as an invasive weed that has caused local extinction of native sand-binding grasses or in some cases is still actively threatening them (Given 1981). As a result marram grass is being sprayed and killed on some dune systems in eastern and southern South Island and replaced with the native pingao (B. Rance pers. comm.). This has implications for the survival of *A. innominata* because pingao does not appear to be one of its larval hosts. As *A. innominata* is a unique noctuid,

we suggest that before any large scale removal of marram grass takes place the site should be searched between December and July for *A. innominata* larvae or pupae. If larvae, pupae or adults are located then marram grass should be retained in those parts of the dune in the meantime. Pingao and suitable hosts of *A. innominata*, eg, sea-shore convolvulus could be planted to provide more natural vegetation cover in adjacent areas.

*Agrotis innominata* and other coastal noctuids occupy habitats that have changed dramatically over the past 150 years from the pingao-dominated communities to marram grass and lupin (*Lupinus arboreus*)-dominated communities. Observations during this short-term study suggest that these noctuid species have been able to adjust their food source to now rely on introduced marram grass as their main food source. Local extinctions may have occurred where this adjustment was not made and they may in combination with the brachyptery of the female, account for the present localised distribution. If *A. innominata* and the other species are successful in their use of marram as a food source it can be predicted that they are likely to increase their range in the future if marram grass is retained in their localities, although the brachyptery in the female of *A. innominata* will limit the rate of spread.

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