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LEACH'S STORM-PETRELS PREY ON LOWER MESOPELAGIC (MYSIDACEA AND DECAPODA) CRUSTACEANS: POSSIBLE IMPLICATIONS FOR CRUSTACEAN AND AVIAN DISTRIBUTIONS

BY

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ABSTRACT

Three species of rarely collected lower mesopelagic crustaceans (the mysid *Eucopia grimaldii*, and the decapods *Sergestes arcticus* and *Hymenodora gracilis*) were found in regurgitated parental food delivered to a breeding colony of Leach's storm-petrels off southern Newfoundland (46°53′N 56°05′W). The known distributions of these crustaceans are consistent with other deep water mesopelagic animals, such as myctophid fish that are the main prey of Leach's storm-petrels in southern Newfoundland. The occurrences of these deep water species as prey support previous contentions that these seabirds forage over deep water and also raises the possibility that these crustaceans may migrate nearer to the surface than previously indicated.

RÉSUMÉ

Trois espèces de crustacés mésopélagiques rarement collectées (*Eucopia grimaldii, Sergestes arcticus* et *Hymenodora gracilis*) ont été trouvées dans la nourriture parentale régurgitée fournie à une nursery de pétrels de Leach au sud de Terre-Neuve (46°53′N 56°05′W). Les distributions connues de ces crustacés sont en concordance avec celles des autres animaux mésopélagiques d'eau profonde, tels que les poissons myctophides qui sont les proies principales des pétrels de Leach dans le sud de Terre-Neuve. La présence de ces proies appuie les assertions antérieures, selon lesquelles ces oiseaux de mer cherchent leur nourriture par-dessus les eaux profondes et laisse aussi envisager la possibilité que ces crustacés migrent plus près de la surface qu'on ne le présumait.

Previous studies of the parental foods of Leach's storm-petrel, *Oceanodroma leucorhoa* (Vieillot, 1817), at breeding colonies (Linton, 1978; Watanuki, 1985; Vermeer & Devito, 1988) and of their distribution at sea (Brown, 1986; Briggs et al., 1987; Pitman & Ballance, 1990; Morgan et al., 1991) have been used to make inferences about the species' feeding areas and foraging ranges. The observations reported here are derived from a study of feeding ecology and reproductive energetics of Leach's storm-petrels (Montevecchi et al., 1992) carried out at a breeding colony on Green Island off the south coast of Newfoundland (46°53′N 56°05′W, fig. 1). The major prey items found in parental regurgitations were small myctophid fish (*Benthosema glaciale* Reinhardt, 1837) and euphausiid and hyperiid crustaceans, similar to findings in an earlier study conducted in southern Newfoundland and Nova Scotia by Linton (1978). Here we describe predation on mesopelagic crustaceans by surface-

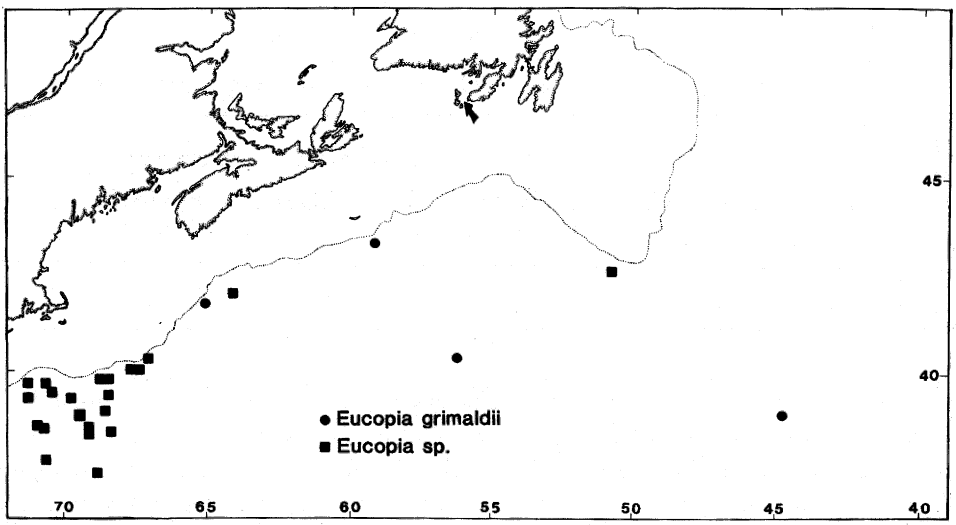

Fig. 1. Collections of *Eucopia* sp. south of Newfoundland. The location of Green Island is indicated with the arrow. The depth contour is 1000 m.

feeding Leach's storm-petrels and draw some inferences about their possible foraging ranges. In view of the poor state of our knowledge of the distribution and systematics of these crustaceans we have summarized what is known at the present time, and also discuss the interactions of the birds and crustaceans.

Regurgitations were collected from storm-petrels attempting to deliver food to chicks in nest burrows on Green Island. Adult storm-petrels were captured in mist-nets set out at night in high density nesting areas during July 1987. When caught in nets food laden parents often regurgitated food which was collected from tarpaulins laid out under the nets. Captured birds were also induced to regurgitate food by inversion before release. Regurgitated food samples from individuals were preserved separately in 10% formalin for later examination in the laboratory.

Three species (5 specimens) of mesopelagic crustaceans were found in 617 regurgitations at Green Island (table I) but none were found in 177 samples collected at a storm-petrel colony on Gull Island (47°16′N 52°46′W) off the east coast of Newfoundland. The distribution based on published records of each of these crustaceans is described and discussed.

Eucopia grimaldii Nouvel, 1942. Although *Eucopia* mysids are the most abundant mesopelagic malacostracan crustaceans in the North Atlantic (Tattersall & Tattersall, 1951; Roe, 1984), their systematics remain confused. It is briefly reviewed here so that the known distributions of the western Atlantic species can be discussed. *Eucopia australis*, the type species was described by Dana in 1852 and *E. unguiculata* by Willemoes-Suhm in 1875. Nouvel (1942) split *E. unguiculata* as defined by Hansen in 1905 into two species which he named *E.*

TABLE I

Mesopelagic Crustacea in Leach's storm-petrel regurgitations

Species	Number	Condition
Mysidacea		
Eucopia grimaldii	1	broken but relatively undigested
Eucopia sp.	1	incomplete
Decapoda		
Hymenodora gracilis	1	incomplete
Sergestes arcticus	2	incomplete

grimaldii and *E. hanseni*. Tattersall & Tattersall (1951) subsequently showed *E. hanseni* to be a synonym of *E. unguiculata*. Banner (1954) reviewed the systematics of *Eucopia*, described extensive variation in *Eucopia* spp., and synonymized *E. unguiculata* and *E. major* with *E. australis*. However, this synonomy has not always been accepted (e.g., Roe, 1984). Banner (1954) also suggested that variation in *E. grimaldii* should be studied to determine the taxonomic validity of the species. To our knowledge this has not been done. Thus, at present, two species of *Eucopia* (*australis* syn. *unguiculata*, and *grimaldii*) are recognized as occurring in the North Atlantic.

E. australis is the dominant species in the eastern Atlantic, where *E. grimaldii* is rarely found (Roe, 1984). *E. australis* in the eastern Atlantic occurs from 300 to 2000 m depth, with maximum catches at 600-900 m. *E. australis* shows both seasonal and diel vertical migrations, but has never been collected at the surface. In the western Atlantic the situation is less clear. Since Nouvel (1943) reported only *E. grimaldii* and no *E. australis* in his samples, the former is probably the dominant species in this region. The specimen from the storm-petrel regurgitations which is complete enough to be identified is of this species. Unfortunately, all the collections of *Eucopia* from the northwest Atlantic which pre-date 1943 have never been reclassified, so it is not known which species they represent.

The distribution of all published records of *Eucopia* in the northwest Atlantic (fig. 1) shows that they have been found off the continental shelf from the region of the Grand Bank southwards. In addition there are four records from the Labrador Sea between southwest Greenland and Labrador that are not shown. Because specimens were collected only from 1000 to 3000 m it is unlikely that these species occur in the Laurentian Channel which extends up into the Gulf of St. Lawrence south and west of Newfoundland but which has a maximum depth of only 500 m.

Hymenodora gracilis S. I. Smith, 1886. The specimen was identified as *H. gracilis* rather than *H. glacialis* (Buchholz, 1874) on the basis of the shape of its rostrum (long and concave) and the presence of a spine on the second segment of the antennal peduncle (Sivertsen & Holthuis, 1956). However, it lacks second

maxillipeds and the carapace has been folded, so the nature of the other two defining characters cannot be ascertained.

Although considered one of the most important pelagic decapod species in the North Atlantic by Murray & Hjort (1912), there are no Canadian records of *Hymenodora gracilis*. It was not listed by Rathbun (1929) or Squires (1965, 1990). In the northwest Atlantic it has been found only as far north as southwest Greenland and its distribution (fig. 2) overlaps extensively with that of *H. glacialis*. The latter species has a more extensive distribution being reported from the Polar Basin to the Bahamas (Chace, 1986). *H. glacialis* has been reported from the Newfoundland Banks (without location), south of Nova Scotia (Squires, 1990) and south of New England (Smith, 1886). *H. gracilis* has been collected at depths ranging from 750 to 6000 m, so it is also not likely to occur in the Laurentian Channel.

Sergestes arcticus Krøyer, 1855. This species is abundant in the North Atlantic and has been recorded from southwest Greenland (70°N) in the Labrador Sea south to 35°N (fig. 3). *S. arcticus* has also been reported in the South Atlantic and off Australia. It has been collected at depths ranging from 250 to 4500 m so it could extend up the Laurentian Channel and has been reported from Hermitage Bay (220-290 m) by Squires (1965, 1990).

Although most of the storm-petrel's food, including *Sergestes*, could have been obtained near the colony the specimens of *Eucopia* and *Hymenodora* were most likely obtained from the vicinity of the continental slope, i.e., a distance of at least 220 km from the colony.

Other studies of surface-feeding avian nektonivores have revealed the presence of deep water species among their food items (e.g., Holthuis & Sivertsen,

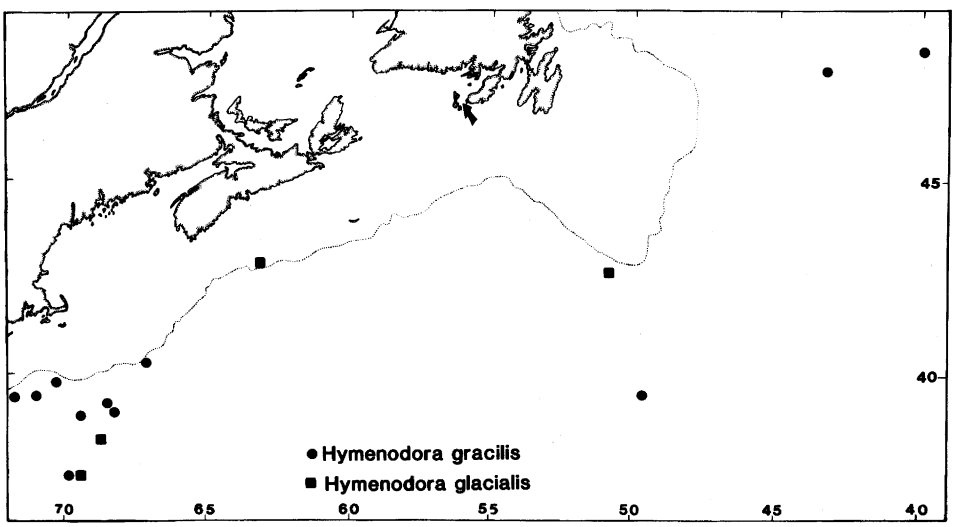

Fig. 2. Collections of *Hymenodora gracilis* and *Hymenodora glacialis* south of Newfoundland.

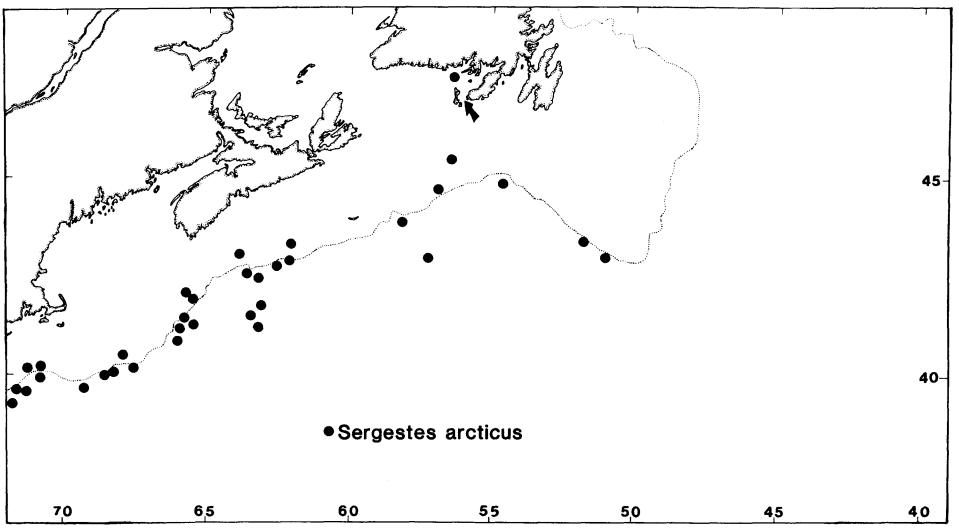

Fig. 3. Collections of *Sergestes arcticus* south of Newfoundland.

1967; Sivertsen & Holthuis, 1980; Ainley et al., 1986; Vermeer & Devito, 1988). Ainley et al. (1984) working in the Antarctic speculated that deep water dwelling species may move upwards to surface waters in response to reduced illumination levels below pack ice. Elliot et al. (1990) also reported increases in the proportions of crustaceans in the diets of thick-billed murres, *Uria lomvia* (Linnaeus, 1758), associated with increased ice cover and decreased surface water temperature. However, the region south of Newfoundland is rarely impinged by pack ice and was not so influenced in 1987. Surface-feeding seabirds have also been observed to feed on crustaceans that may have been injured by pursuit-diving birds or other subsurface predators (e.g., Braune & Gaskin, 1982; Hunt et al., 1988). The mesopelagic crustaceans found in the present study and in previous studies (Holthuis & Sivertsen, 1967; Sivertsen & Holthuis, 1980) inhabit depths well below the diving ranges of northern hemisphere pursuit-diving seabirds. Although the mesopelagic crustaceans found in this study are abundant, they have never been caught in nets towed at the surface in either the eastern or western Atlantic.

The occurrences of mesopelagic crustaceans in the food loads of storm-petrels raises the possibility that these crustaceans may migrate closer to the surface than previously demonstrated (see also Holthuis & Sivertsen, 1967; Sivertsen & Holthuis, 1980). Avian dietary data provide an alternate means of documenting the occurrences and distributions of prey species (Ashmole & Ashmole, 1968) independent of conventional sampling gear. In several instances new species have been collected as avian prey (Sivertsen & Holthuis, 1980; Vermeer & Devito, 1989), indicating the value of seabirds as samplers of the marine fauna.

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