FURTHER DATA ON FOOD ITEMS OF NORTHERN SAW-WHET OWLS (*AEGOLIUS ACADICUS BROOKSI*) ON THE QUEEN CHARLOTTE ISLANDS, BRITISH COLUMBIA

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Mammals dominate the list of prey items taken by the widespread nominate subspecies of the Northern Saw-whet Owl (*Aegolius acadicus acadicus*) throughout its range, including the Pacific Northwest (Forsman and Maser 1970, Boula 1982, Grove 1985). *Aegolius acadicus brooksi*, the only other subspecies recognized, is endemic to the Queen Charlotte Islands or Haida Gwaii, British Columbia (Cory 1918, AOU 1957, Sealy 1998), whence limited information has shown that its diet includes invertebrates—primarily from the intertidal zone—as well as vertebrate taxa in addition to small mammals. Previous data on *brooksi* came from examination of digestive tracts of 16 adults and one juvenile salvaged between 1977 and 1986, primarily in nonbreeding seasons, and from stable-carbon-isotope analyses of tissues of 12 of these specimens (Hobson and Sealy 1991). In addition to marine invertebrates, two individuals had taken Dusky Shrews (*Sorex monticola*), and a published reference was noted to fledglings with remains of passerine birds in their digestive tracts. Cowan (1989) listed the Northern Saw-whet Owl among the birds of the Queen Charlotte Islands that forage primarily away from the sea or shore, but little information was available on the food habits of *brooksi* at that time. Since the publication of Hobson and Sealy's (1991) results, further data on food items of *brooksi* have become available, and I give them here.

METHODS AND RESULTS

Sources of Information on Prey Items

Information on food habits obtained since Hobson and Sealy (1991) has come from (1) a specimen in the Cowan Museum of Zoology, University of British Columbia (UBC), (2) contents of digestive tracts (hereafter stomachs) of nine adults and one juvenile, examined 1990–1997, (3) examination of 11 pellets, and (4) direct observations of individuals foraging. Whole and fragmentary invertebrates and vertebrate prey items from stomachs and pellets are stored in the University of Manitoba Museum of Zoology (UMZM). Invertebrates and lower jaws of mammalian prey were compared to reference material collected on the Queen Charlotte Islands in 1986 (Hobson and Sealy 1991) and housed in the Royal British Columbia Museum and UMZM. Remains of Ancient Murrelets (*Synthliboramphus antiquus*) were identified by their distinctive down feathers and bone fragments; other bird remains were identified from portions of mandibles and entire primaries. Food items from all sources examined in this study (stomach contents, pellets, literature, museum specimen, and field observations) are summarized Table 1.

Table 1 Prey items of *Aegolius acadicus brooksi*

Species[a]	Samples with species (%)[b]
Invertebrates	
Amphipoda (*Orchestria traskiana, Orchestoidea californiana*)	46.3
Isopoda (*Ligia pallasii*)	7.3
Diptera (*Coelopa vanduzeei*)	7.3
Unidentified insect parts	2.4
Arachnida (*Anyphaena* sp.)	2.4
Amphibians	
Western Toad (*Bufo boreas*)	2.4
Birds	
Ancient Murrelet (*Synthliboramphus antiquus*)	7.3
Chestnut-backed Chickadee (*Poecile rufescens*)	2.4
Golden-crowned Kinglet (*Regulus satrapa*)	2.4
Hermit Thrush (*Catharus guttatus*)	2.4
Unidentified bird remains	4.9
Mammals	
Dusky Shrew (*Sorex monticola*)	9.8
Deer Mouse (*Peromyscus* sp.)	7.3

[a]From 41 sources: stomachs, including those examined by Hobson and Sealy (1991), containing at least a trace of prey remains (n = 26), pellets (n = 11), records from the literature (n = 2), a museum specimen (n = 1), and an observation of foraging where the prey item was identified (n = 1). More than one prey species sometimes occurred in the same stomach or pellet.

[b]Presence only, not absolute numbers of individual prey items.

Contents of Stomachs

Hobson and Sealy (1991) recorded *brooksi* eating predominantly invertebrates: sand-hoppers (the amphipods *Orchestria traskiana* and *Orchestoidea californiana*), seaweed flies (*Coelopa vanduzeei*), isopods (*Ligia pallasii*), and a juvenile spider (either *Anyphaena aperta* or *A. pacifica*). The spiders are not known to inhabit beaches; *A. aperta* occurs on tree foliage, *A. pacifica* in forest litter (R. A. Cannings pers. comm.). The other groups inhabit beaches in the region of the upper tide line and splash zone.

Additional records of invertebrate prey taken by *brooksi* have been obtained. A female (UBC 921) collected 1 September 1946 bears the notation "spider," removed from the bird's digestive tract. On 7 March 1995 Phred Collins (pers. comm.) noted the remains of sand-hoppers in a pellet regurgitated by a female owl hit by a vehicle; later I noted amphipod fragments in its stomach. The stomach of a male (4 November 1994) contained 47 intact individuals plus fragments of *Orchestoidea californiana* and a partial upper mandible, piece of cranium, and feathers of a Chestnut-backed Chickadee (*Poecile rufescens*). The stomach of a male (undated) contained amphipod fragments, and a female (15 January 1995) and a male (19 March 1996) salvaged near Masset had eaten 63+ and 54+ *O. californiana*, respectively. The stomach of a female (19 November 1996) contained amphipod fragments, that of a juvenile killed by a cat in August 1997 near Skidegate Inlet 16 amphipods plus fragments (*O. californiana*) and five isopods (*Ligia pallasii*).

Patch (1922) removed passerine feathers from stomachs of two fledglings collected on 21 July 1919 that "will probably prove to be [those] of some warbler." I did not locate these feathers. Stomachs of two adult females taken in 1946 contained a few feathers, which Ian McTaggart-Cowan (pers. comm.) believed were from an owl. Stomachs of a female (1 October 1990) from Moresby Island and of a male (21 November 1996) from Masset contained a Dusky Shrew and several shrew hairs, respectively.

Contents of Pellets

I examined 11 pellets, 10 collected on East Limestone Island (see map in Sealy 1998) by Robert Kelly in June 1997, from a roost used by two individuals, and one from Graham Island (examined by Collins). The pellets from East Limestone Island averaged 30.3 ± 4.7 (standard deviation) mm long and 15.4 ± 0.7 mm wide and contained the remains of two downy Ancient Murrelets, one Hermit Thrush (*Catharus guttatus*), one Golden-crowned Kinglet (*Regulus satrapa*), two Dusky Shrews, and three deer mice (*Peromyscus* sp.).

Observations of Northern Saw-whet Owls Hunting or Carrying Prey

Recent observations of saw-whet owls at or traveling to or from the tide line point to foraging in the intertidal zone or upper beach. On 5 April 1971 on Langara Island, I netted one (Sealy 1998) just above the splash zone on a sand beach, about 30 m from the nearest trees. The capture site suggests travel to or from the beach. Over a 2-year period through 1997, Frank Reindl (pers. comm.) saw about 15 Northern Saw-whet Owls flying toward and from the beach along the coast highway between Tlell and Skidegate. Finally, on 10 September 1997, Kelly (pers. comm.) observed foraging on sand beaches on two islands off the west coast of Moresby Island. On Helgeson Island, he saw a saw-whet owl foraging at 2300 along a line of rotting kelp washed by waves on a rising tide; for about 10 minutes, the owl hopped and flew back and forth along a 2-m strip of kelp. A second individual was observed standing in rotting kelp at the upper tide line on adjacent Saunders Island later the same night. Sand-hoppers, isopods, and seaweed flies are particularly numerous along the upper beaches at this stage of the tidal cycle (pers. obs.).

On 17 June 1974, about 15 km south of Sandspit, R. Wayne Campbell (pers. comm.) saw a Northern Saw-whet Owl perched on a snag, holding a Western Toad (*Bufo boreas*) in its claws. Minutes later, the owl carried the toad into the woods. One afternoon in June 1997 on Anthony Island, Collins (pers. comm.) saw a saw-whet owl investigate two Hermit Thrush nests, but at each nest the thrushes repelled the owl. Numerous observers have suggested or reported that *brooksi* takes newly hatched Ancient Murrelet chicks at night as they descend the slopes from their burrows to the sea. Blood et al. (1979) watched one chase an Ancient Murrelet chick on the floor of the colony on Lyell Island but did not ascertain if it was successful. Also on Lyell Island, Rodway et al. (1988) heard saw-whet owls calling at night during the murrelets' breeding season. On East Limestone and Reef islands, Gaston (1992) found Ancient Murrelet down feathers in pellets and

heard owls calling in the colony more frequently when the chicks departed for the sea than at other times of the year. On 31 May 1996, Campbell and others watched a saw-whet owl fly off with a downy Ancient Murrelet captured en route to the sea and observed a second one eating a murrelet chick. In the late 1970s, Tom E. Reimchen (pers. comm.) observed one pursuing a bat over Drizzle Lake. The labels of three specimens of nominate *acadicus* from southeast Alaska note the remains of a Little Brown Bat (*Myotis lucifugus*) removed from the stomach in one, a shrew in the second, and a vole (*Microtus* sp.) in the third.

DISCUSSION

This new information extends Hobson and Sealy's (1991) findings that *Aegolius acadicus brooksi* feeds on a wide array of taxa. Prey items and intended prey identified so far represent several groups of invertebrates, an amphibian, small birds, and small mammals. The large numbers of invertebrates in the samples, however, signify the importance of marine-derived protein in the diet of these owls, at least at the end of the breeding season and during the nonbreeding season.

On the surface, available information suggests that *brooksi* takes a wider range of prey than does nominate *acadicus*. Nonmammalian prey constitutes less than 5% of the prey species of both eastern and western populations of *acadicus* (Cannings 1993). Lists of prey items from the Pacific Northwest are dominated by species of *Peromyscus* and *Microtus*. Of 36 individuals removed from pellets collected in Oregon, all but one were small mammals (Forsman and Maser 1970). Also in Oregon, of 77 prey from 57 pellets, 74 (96%) were mammals (Boula 1982). In Washington, Grove (1985) identified 770 prey items from more than 900 pellets, of which more than 95% were small mammals. The apparent dominance of small mammals in the diet of *acadicus*, however, may reflect the lack of information on prey taken by coastal populations of this subspecies. Furthermore, the prey items sampled above came only from pellets, whereas data on the diet of *brooksi* have come from observations of owls foraging, stomach contents, and isotope analysis of tissues, as well as pellet examination. Coastal populations of *acadicus* possibly concentrate on marine invertebrates at certain times of the year, but this has not been confirmed.

Analysis of stable carbon isotopes permits the determination of the relative contributions of protein derived from marine and terrestrial ecosystems to the diets of birds. By examining both muscle and bone collagen, Hobson and Sealy (1991) ascertained both short-term (i.e., on the order of several weeks) and long-term (i.e., approaching the lifetime of the individual) dietary information. The collagen signal in young birds, however, reflects the diet at a time when the bones are growing. Hobson and Sealy (1991) found that most *brooksi* sampled had eaten some marine protein; two females salvaged in autumn had fed exclusively on marine protein. The remaining individuals showed little, if any, long-term marine contribution to their diets. The measurements indicated that marine-based foods make up 10% to 15% of the lifetime diet of the owls. Muscle tissue of an October juvenile (Sealy 1998) showed a marine contribution to the diet of approximately 50%

(Hobson and Sealy 1991). Isopods and amphipods taken by the juvenile in 1997 reveal that marine-derived foods may be taken soon after fledging, possibly as soon as the young owls can fly and forage on their own.

Stable-carbon-isotope and stomach-content analyses suggest that some *brooksi* specialize on protein derived from the marine environment during the nonbreeding season. Others take primarily terrestrial prey items or both marine and terrestrial food, as indicated by a stomach that contained a bird and intertidal invertebrates. Prey used may reflect the location of home ranges of individual owls, whether adjacent to the coast or inland, and whether the sites are stable year round. How far owls travel to obtain marine prey is not known.

Northern Saw-whet Owls also are opportunistic foragers, as some individuals take Ancient Murrelet chicks that are available only for 5 to 6 weeks each year (Sealy 1976, Gaston 1992). Gaston (1992) suspected that they specialize on *Peromyscus* on East Limestone Island, and the remains of these mice in some pellets collected there support his contention. Shrews and deer mice are widely distributed on Graham and Moresby islands, and each small island where *brooksi* has been reported (see Sealy 1998) supports populations of *Peromyscus* (Foster 1965), breeding murrelets and passerines (Campbell 1969, Rodway et al. 1988) and, of course, terrestrial and marine invertebrates.

SUMMARY

Prey items taken by *Aegolius acadicus brooksi* on the Queen Charlotte Islands were obtained from 41 sources: stomach contents (including those examined by Hobson and Sealy 1991), pellets, records from the literature, a museum specimen, and observations of foraging or carrying prey. Twelve species were identified among the prey items: five invertebrates (mostly from the intertidal), a toad, a seabird, three passerines, and two small mammals.

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