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MASS APPEARANCE OF LADY BEETLES (COLEOPTERA: COCCINELLIDAE) ON NORTH CAROLINA BEACHES[1]

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ABSTRACT: A mass appearance of lady beetles on the North Carolina coast was investigated in May of 1996. Six species of lady beetles were identified, with *Hippodamia convergens* and *Coccinella septempunctata* predominating. It is suggested that the insects were first-generation adults dispersing from senescing grain fields.

Several publications document the sudden appearance of hordes of lady beetles (Coccinellidae) on the beaches of oceans and large lakes (Oliver, 1943; Hagen, 1962; Rothschild, 1971; Yan et al., 1983; Majerus and Majerus, 1996). These sporadic mass appearances are not associated with dormancy or aggregation and are usually attributed to the weather. Wind patterns concentrate masses of flying beetles and drop them into bodies of water; large numbers of beetles subsequently wash up on beaches as the result of wind and tides. The number of beetles involved can be staggering. Oliver (1943), for example, described a drift line of dead *Coccinella undecimpunctata* L. at least 13 miles long with 70,000 beetles per linear foot. In the United States the phenomenon has been reported by Lee (1980) in the Great Lakes of the upper midwest, and by Schaefer et al. (1987) along the coast of Delaware. Hagen (1962) reported that masses of *Hippodamia convergens* Guérin-Méneville are occasionally deposited in the Pacific Ocean.

We had the opportunity to investigate reports of a large number of coccinellids washed up on a beach in the city of Kitty Hawk (36.07°N, 75.72°W) on one of North Carolina's barrier islands. Local residents reported that the lady beetles arrived in large numbers on 18 May 1996. On 25 May 1996 we collected and identified 919 insects from debris east of the primary dune. Of these, 96% were predaceous coccinellids, 3% were other Coleoptera, and 1% were assorted Hemiptera and Diptera. Seven percent of the insects were alive when collected, and all but the Diptera were identified to species (Table 1). Six species of lady beetles were collected, with *Hippodamia convergens* and

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Coccinella septempunctata L. dominating (55.8% and 41.5% of Coccinellidae collected, respectively).

To determine if this mass appearance was a localized anomaly, one week later (1 June 1996) we visited Wrightsville Beach, NC (34.21°N, 77.80°W), 281 km south of Kitty Hawk. Seventy-two dead beetles were collected in debris at this location: *H. convergens* (51.4%), *C. septempunctata* (44.4%), *C. munda* (2.8%), and *C. maculata lengi* (1.4%). The three non-coccinellids collected were identified as *Chrysomela scripta* (Fabricius). These beetles were all dead and infrequently encountered. We suspect that the insects collected at both Kitty Hawk and Wrightsville Beach were remnants of the same phenomenon, but most of the beetles at the latter location had washed or blown away by the time we visited.

The species collected at Kitty Hawk are a common assemblage of lady beetles in North Carolina and are reported in varying proportions from crops and ornamental plantings (Kidd, 1996; Nault, unpublished data; Nalepa, unpublished data). All are aphidophagous to varying degrees, conforming to the prevailing hypothesis that mass appearances of lady beetles on beaches are related to the nature of their aphid diet (Hodek, 1973; Hodek et al., 1993). Aphids rapidly increase in number under favorable conditions, but this abundance is sporadic and ephemeral in most habitats (Hodek, 1973). Aphidophagous lady beetles, in turn, have evolved two traits that predispose them to tracking prey of this nature. First, they are able to respond to an abundance of prey with spectacular increases in population size (Hagen, 1962; Hodek, 1973; Hodek and Honek, 1996; Majerus and Majerus, 1996). Dickson et al. (1955), for example, estimated that nearly 54,000 adult coccinellids emerged from one acre of alfalfa heavily infested by aphids. Second, aphidophagous lady beetles are more nomadic than species that use other food sources, and may switch among several habitats with suitable prey during one vegetational season. They are especially prone to fly when hungry (Ewert and Chiang, 1966a,b; Hodek et al., 1993; Hodek and Honěk, 1996; Majerus and Majerus, 1996).

In explaining the mass shoreline appearances of aphidophagous coccinellids, Hagen (1962) proposed a plausible chain of events subsequently echoed and endorsed by other authors (Hodek, 1973; Hodek and Honěk, 1996; Majerus and Majerus, 1996). Favorable environmental conditions, i.e., massive aphid populations and optimal weather, allow for a high fecundity of female coccinellids and a low mortality of larvae and pupae. Juvenile populations build quickly, and when the young adult beetles of this generation emerge, there is stiff competition for remaining prey. Hunger increases their mobility, and a hot day may bring them into the air by the millions; beetles in flight may be further concentrated by thermals and prevailing winds. The insects are brought back to earth *en masse* by air currents at the coast and perhaps a reluctance to cross expanses of water. Those that land in water are washed back onto the coast by wave action and tides.

Hodek and Honěk (1996) consider the species composition of these mass appearances purely accidental "pseudo-communities" that may not resemble coccinellid communities of any habitat in the vicinity; they cite Klausnitzer's (1989, 1992) work on the German coast of the Baltic Sea. This researcher compared relative abundance of coccinellid species from seashore collections with those present in nearby pine forests and found little correlation. The timing and species composition of the mass appearance of coccinellids on North Carolina beaches in 1996, however, suggests the possibility that these originated in grain fields prevalent in the eastern half of the state. First, nearly 700,000 acres of small grains were harvested in this area of North Carolina during 1995; harvest typically begins in late May and early June (Meadows, 1996). Second, adults of the first generation of coccinellids emerge in late May, at about the same time grain is senescing (Kidd, 1996; Nault, unpublished data). Third, over most of North Carolina prevailing winds near the earth's surface blow from the southwest. The direction may be interrupted and reversed due to offshore storms or diurnal fluctuations (Hardy et al., 1967). Fourth, two of the major species comprising the beach population were also abundant in nearby grain fields. Lady beetles swept from wheat at the Tidewater Research Station near Plymouth in Washington County on 3 May 1996 consisted of 38.3% *C. septempunctata*, 30.4% *H. convergens*, and 31.3% *C. maculata* (n = 240) (Kidd, 1996).

The presence of *C. septempunctata* and *H. convergens* at the beach is not difficult to explain. *C. septempunctata* is primarily an aphid predator (Gordon, 1985) prone to population explosions (Hodek and Honěk, 1996; Majerus and Majerus, 1996), is a strong flier (Marriner, 1939), and is the dominant species collected from mass aggregations on coastlines (Rothchild, 1971; Yan et al., 1983; Schaefer et al., 1987). During the breeding period, the most important movements of *C. septempunctata* in Europe occur after aphids disappear from cereal stands, when the emergence of new adults more or less coincides with a decline in aphid populations in the fields (Hodek and Honěk, 1996). *H. convergens* represented a higher proportion (55.8%) of our beach collection than has been reported in the past. In the coastal collection described by Schaefer et al. (1987), for example, just 5.3% were identified as *H. convergens*. This coccinellid is strictly aphidophagous, and can be the most abundant species present in cereals (Gordon, 1985; Hodek and Honěk, 1996: Table 5.16). If the lady beetles that appeared on the North Carolina coast in 1996 indeed originated from small grain, then *Coleomegilla maculata* is conspicuous by its relative absence from the beach. Although its scarcity might be due to variation in demographic parameters (i.e., adults of the first generations of *C. septempunctata* and *H. convergens* may have emerged and flown while *C. maculata* were still pupae), we think a better explanation lies in host range differences among species. While the primary food source of *C. septempunctata* and *H. convergens* is aphids, *C. maculata* is perhaps the most polyphagous lady beetle

known, feeding on aphids, other insect prey, insect eggs, fungi, and pollen (Hodek, 1973; Hilbeck and Kennedy, 1996). Up to 50% of the diet of *C. maculata* can be composed of pollen from various plants (Forbes, 1883). As such, the life history of this species is not strongly tied to aphid demographics (Ewert and Chiang, 1966b), and it is less prone to long distance movements (Hodek and Honěk, 1996). After the collapse of aphid populations in small grain, new adults of *C. maculata* can support themselves on nearby alternative food instead of undertaking a risky dispersal flight in search of aphid prey. Voucher specimens have been deposited in the North Carolina Department of Agriculture Insect Collection, Raleigh.

Table 1. Insect species collected from beach debris at Kitty Hawk, North Carolina, on 25 May 1996 (n = 919 insects; 7 Diptera were not identified).

Family	*Species*	*No.*
Coccinellidae	*Hippodamia convergens* Guérin-Méneville	493
	Coccinella septempunctata L.	367
	Cycloneda munda (Say)	15
	Harmonia axyridis (Pallas)	6
	Coleomegilla maculata lengi Timberlake	2
	Anatis labiculata (Say)	1
Scarabaeidae	*Macrodactylus angustatus* (Beauvois)	3
Chrysomelidae	*Diabrotica undecimpunctata howardi* Barber	8
	Chrysomela (*Microdera*) *scripta* (Fabricius)	7
	Leptinotarsa decemlineata (Say)	5
	Calligrapha (*Coreopsomela*) *californica coreopsivora* Brown	2
Saldidae	*Saldula major* (Provancher)	1
Pentatomidae	*Neottiglossa* (*Texas*) *cavifrons* Stål	1
Cydnidae	*Sehirus cinctus* (Beauvois)	1

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