Mass migration: description and function

Mass single-file migrations for several days across many kilometers of shelterless substrate take place under specific circumstances and in certain regions (Herrnkind and Cummings 1964, Herrnkind and McLean 1971, Herrnkind et al 1973, Kanciruk and Herrnkind 1976, 1978, Herrnkind 1985). Annual mass movements take place mainly in late fall or early winter, later in lower latitudes, but occasionally at other seasons, sometimes coinciding with hurricanes; not all causes are understood. In Bimini, Bahamas during the early fall, late juvenile and young adult lobsters forage nomadically over thousands of square kilometers of 3-10m deep shallows of the Little and Great Bahama Banks. These regions are a mosaic of sand, hardbottom and seagrass patches where sparse shelter is provided mainly by occasional rock crevices, coral heads, sea whips and large sponges. Annually, about mid-autumn (late October-early November), the benign conditions of the shallows are sharply disrupted by severe storm fronts with several days of high winds, drastically declining temperatures, water turbulence from large swells, and associated turbidity from stirred sediment. The storms trigger a mass movement of lobsters across the shallows to the oceanic fringe where they scatter along the deeper, less disturbed reefs.

Off the west coast of Bimini, tens of thousands of migrants pass southward day and night for several days in oriented queues of up to 65 individuals swamping the patch reefs with hundreds of lobsters and filling large crevices by day. On shelterless substrate, smaller groups in stationary roestte formations rest before continuing. Resting migrants resume moving in the late afternoon just before sunset, leaving crowded dens mainly in short queues that join with others as they make chance contact in the open. After several days, most migrants have moved from the previously crowded areas and scattered along the 30km migratory pathway in depths of 10-30m, although some remain on any available patch reefs. There is no compelling evidence of a return mass migration but tagged individual migrants have been recovered back on the shallow bank.

The mass migration is hypothesized to be an exodus from the disturbed shallows (see Herrnkind 1985) that in episodic years become too cold and turbulent for the lobsters to maintain normal activities and in some cases can kill molting individuals (Davis 1978). The movement does not directly serve reproduction because mating begins 4-6 months later after most of the fall migrants have scattered among other habitats, including the area they left the previous fall (Kanciruk and Herrnkind 1976). Available evidence further disfavors leaving because of prey decline or intraspecific overcrowding while the mix of

ages of both sexes among migrants, including late juveniles, newly mature adults and old adults, argues against an ontogenetic spatial shift to a different habitat. The movements do not constitute long distance homing across regions because the migrations last only days in a given region, comprise individuals typical of distinctive regional populations and involve distances of only 30-50km with divergent migratory bearings. In conjunction with the dispersing larval stage the strong locomotory ability of this species (and several others) underlies its ability to exploit valuable but widely spaced habitats throughout its life cycle.

Queuing across open substrate. The main features of a queue moving at migratory speed include the following: 1) striking linear alignment of the longitudinal body axes; 2) consistent interlobster positioning among followers maintained by continuous tactile contact of the antennular inner rami and foremost walking leg tips with the dorsolateral edges of the extended abdomen and tailfan of the lobster ahead; 3) antennae held level with the substrate directed forward at ~45 degrees lateral of the long body axis; 4) walking propulsion mainly by the posterior three pairs of walking legs with intermitent use of the anterior pairs; 5) lead lobster size (age) distribution same as followers; 6) lead position changes frequently but irregularly; 6) queuing behavior is alike in daylight or darkness. The formation becomes more sinuous as the leader slows, often becoming two or three across as followers break rank and slide forward while still keeping intermittent antennal contact with the adjacent part of the line. This sometimes results in separate queues forming with one or both resuming migratory pace and direction. Otherwise, the followers reshuffle into a single file as the original leader picks up speed. When approached from the side by a diver, the queue members extend the nearside antennae but sustain oriented movement. Deft removal of the leader by quickly snaring or netting, so as not to stop or disrupt the group, results in the next in line leading the queue in the migratory bearing (Herrnkind and Kanciruk 1978).

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