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Novel Foraging in the Swash Zone on Pacific Sand Crabs (*Emerita analoga*, Hippidae) by Mallards

Kevin D. Lafferty,^{1,3,4} John P. McLaughlin,² and Jenifer E. Dugan³

ABSTRACT.—Mallards (*Anas platyrhynchos*) have been observed foraging on intertidal Pacific sand crabs (Hippidae, *Emerita analoga*) in the swash zone of sandy beaches around Coal Oil Point Reserve, California, and several other beaches on the west coast since at least November 2010. Unlike foraging shorebirds, Mallards do not avoid incoming swashes. Instead, the incoming swash lifts and deposits them down the beach. Shorebirds and diving ducks commonly feed on sand crabs, but sand crabs appear to be a novel behavior and food source for Mallards. Previous surveys of beaches did not report foraging Mallards on regional beaches, whereas foraging Mallards were common in contemporary (recent) surveys and anecdotal reports. Observations of this potentially new behavior were separated by

as much as 1,300 km, indicating that this was not a local phenomenon. Mallards foraged singly, in pairs, and in flocks. An expansion of diet to sand crabs carries risks of exposure to surf, human disturbance, high salt intake, and transmission of acanthocephalan and trematode parasites for Mallards but has the benefit of providing a dependable source of animal protein. *Received 23 August 2012. Accepted 10 November 2012.*

Key words: beach, behavior, duck, foraging, Mallard, parasites.

We watched as a swash (the part of a broken wave that washes up a beach) approached a Mallard (*Anas platyrhynchos*) from behind, lifted it, and deposited it down the beach; the bird then stuck its bill in the sand, swept it from side to side, dug, captured a Pacific sand crab (*Emerita analoga*) and swallowed it; this occurred again and again. Here, we report on this potentially

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novel foraging habitat and diet for Mallards. The only other ducks known to feed on sand crabs are scoters (e.g., *Melanitta perspicillata*), which usually dive for crabs in the surf zone but will occasionally feed standing in the swash zone (the part of the beach that is alternately covered and exposed by incoming and outgoing broken waves). Black Brant (*Branta bernicla nigricans*) will sometimes feed in the surf zone on sand crabs (KDL, JPM, and JED, pers. obs.). After searching for observations by other beach goers and examining recent surveys of birds on beaches, we hypothesize that this behavior has recently emerged among Mallards and is now common and widespread in southern and central California. We further consider the costs and benefits of sand crabs as a food source.

Non-breeding Mallards are opportunistic foragers, mostly eating seeds and invertebrates (Hughes and Young 1982). Breeding Mallards increase their intake of invertebrate protein prior to breeding to attain necessary resources for egg formation (Swanson et al. 1979). Mallards feeding in estuaries have broad diets and will eat marine snails, spiders, insect larvae, isopods, and amphipods (Eamer 1985). They commonly sweep their bills from side to side through the sediment while they search for invertebrates. The ability of Mallards to thrive in human-dominated settings is a testament to their flexibility and ability to forage opportunistically, and there are six novel food innovations previously reported for Mallards in the literature (Overington et al. 2009).

Pacific sand or mole crabs (*E. analoga*) are an important part of the sandy beach food web making up 80–90% of the intertidal invertebrate biomass and reaching densities that exceed 84,000 individuals/m of shoreline in southern California (Dugan et al. 2003). These anomuran crabs are active tidal migrants that live in the swash zone of sandy beaches on the West Coast of the Americas with congeners inhabiting beaches in many other regions of the world (Efford 1976). Postlarval crabs (megalopae, 3–4 mm carapace length) recruit to intertidal beaches en masse from the plankton during late winter and spring months. While buried in shallow wet sand, crabs filter plankton from receding waves in the swash zone. Crabs occur in dense patches or aggregations (Efford 1965) detectable by sight or feel. The ovoid shaped crabs (up to 35 mm carapace length) lack defensive claws and large spines and are a staple prey for migrating shorebirds, gulls, and

diving ducks (Kvitek and Bretz 2005). In addition, Common Ravens (*Corvus corax*) have been seen excavating sand crabs in order to eat their egg masses (Hendricks and Hendricks 2011).

We first observed a pair of Mallards foraging on the washed intertidal zone of the beach at Coal Oil Point Reserve in Santa Barbara County on 11 May 2011, and again, about 6 km to the east, on the beach below More Mesa on 20 May 2011. Since that time, observations have been regular at Coal Oil Point Reserve and elsewhere (see below), including groups of up to 16 birds. On 11 October 2011, two Mallard were observed foraging on sand crabs at Arroyo Quemado (25 km to the west). On 14 December 2011, Mallards were observed foraging in the swash zone of the Ventura River Mouth, in Ventura County (55 km to the east of the original observations). On 7 March 2012, we observed two Mallards foraging on sand crabs north of the Scripps Pier in San Diego (290 km to the south east). During contemporaneous shorebird surveys at four beaches around the UCSB campus, no Mallards were seen during six surveys between 28 February 2010 and 22 December 2011. However, in 2012, Mallards were seen during five of eight surveys, specifically: 25 January (five Mallards at Devereux Beach), 18 March (five Mallards at Devereux Beach), 6 April (two Mallards at Sands Beach), 4 May (two Mallards at Ellwood Beach), and 27 May (five Mallards at Ellwood Beach and three Mallards at Sands Beach).

We expected other beach visitors would have reported similar observations. Early on, we asked local naturalists if they had ever seen the behavior. None had, and all expressed surprise at the possibility. Later, some of these individuals reported seeing the observations themselves. In May 2012, we searched online for various combinations of “Mallard,” “duck,” “sand crab,” “mole crab,” and “beach” and searched the Santa Barbara County Birding website for 878 records of “Mallard.” This search returned a prior observation of this behavior from November 2010 near Coal Oil Point. In addition, subsequent reports were made at various beaches in Southern and Central California (Haskell’s Beach, Campus Point, Corona del Mar Beach, Scripps Pier, Arroyo Grande Creek Lagoon, Pismo Creek, Morro Strand and Cayucos Pier). Where possible, observers were contacted to elaborate on their observations. All observers indicated their surprise at seeing Mallards foraging on the beach. Finally, David Lauten from Portland State Uni-

versity communicated that pairs of Mallards were commonly observed in the shallow surf at Coos Bay North Spit, Coos County, Oregon. Assuming these ducks were feeding on sand crabs, this is the northernmost record of this behavior to our knowledge.

We then consulted historical data sets from local beaches to see if Mallards had been reported from the swash zone in California in the past. These were (1) >2300 surveys of a 1-km transect on Devereux Beach, west of Isla Vista since 1992 [See Hubbard and Dugan (2003) for study site details], (2) 720 larger-scale monthly surveys of birds on 1-km transects at 20 beaches in San Luis Obispo and Santa Barbara Counties from 1998–2001 (JED and D. M. Hubbard, unpubl. data), (3) 48 weekly surveys along a 2.85 km transect of the beaches around Coal Oil Point Reserve during 1999 (Lafferty 2001), and (4) 490 1-km monthly beach transects at 14 Ventura County beaches from July 2007 to May 2010 (Rodriguez et al. 2011). Mallards were occasionally present on some beaches but usually in association with estuaries or ponds. Rarely, they were in the low intertidal zone. In no case were Mallards reported as feeding in the swash zone, further suggesting that our observations are novel.

To determine if recent observations represent an increase in Mallards on the beach coincident with observations of foraging, we compared Hubbard and Dugan's (2003) counts of Mallards before and after 2010. Before 2010, there were 0.049 (SD = 0.023) Mallards observed per beach survey. However, since 2010, there have been 0.50 (SD = 0.055) birds seen per survey (with the greatest counts in the fall (1.46) and lowest counts in the summer (0.02), suggesting that observations of swash-zone foraging have coincided with a higher density of Mallards at this beach site. This ten-fold increase is much greater than the regional doubling of Mallards seen in Christmas Bird Counts in Santa Barbara County for the same period (National Audubon Society 2011).

There may be a number of new risks for Mallards that forage on sand crabs. Sand crabs are a first intermediate host to the acanthocephalan *Proflicolus (Polymorphus) kenti* and the trematode *Microphallus (Spelotrema) nicolli* (Smith 2007). These parasites are in a larval form in the crab and become an adult in the intestine of birds. Similar acanthocephalans and trematodes have been found in Mallards, which can be exposed while feeding on amphipods. Eating adult sand

crabs could lead to high intensities of infection with unknown health consequences. Smith (2007) found that sand crabs were more heavily infected at locations with many birds, and that infection with acanthocephalans was higher in June (site average of 0.2–2 worms/crab) than in November (site average of 0.1–0.3 worms/crab), and infection with trematodes was higher in November (site average of 1–50 worms/crab) than in June (site average of 1–18 worms/crab). It is difficult to quantify the net effect of these hazards, but the benefit of an abundant, easy to find, and protein-rich prey source may outweigh these costs. Fresh carcasses of Mallards from beach areas could be dissected for parasites to determine the potential for pathology.

Together, our observations indicate that Mallards might have recently begun foraging on sand crabs along a long stretch of coastline in southern California. Swash zone foraging is not reported in the literature and regular beach goers find the observation surprising. Despite substantial survey effort, we have no observations of this behavior prior to November 2010, but occurrences are now so common that in 2012 they were seen on more than half of our surveys. However, it is not clear why Mallards would only now feed on sand crabs, given that this plentiful resource has always been available. It is possible that this behavior is a recent by-product of adaptation to human-dominated landscapes. Mallards commonly occur at wetlands and parks near sandy beaches and are tolerant to human activities. Continual exposure to novel feeding opportunities in these areas might have eventually predisposed some Mallards to mimic shorebirds feeding in the swash zone. In any case, Mallards can now be considered a part of the sandy beach food web along the west coast.

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