separately for shells prsented in three different orientations which matched as closely as possible the feeding method speialisms of Oystercatchers.

Speakman concludes by saying that my conclusion that the effects of bias in shell collections are likely to be negligible "is dependent upon the bias he detected and, as revealed in the current paper, this may be due to a gross undervaluation of bias for most studies which use searching procedures more closely marched by the test described here". In fact I concluded that "the main conclusion from **the present study** is that recoveries of mussel shells are also biased, but the effect of this is likely to be negligible during most months of the year, because Oystercatchers avoid the size-classes which are most prone to recovery bias". I further qualified this by pointing out that "in spring, when Oystercatchers on the Exe took small mussels, estimates of energy intake based on shell recoveries were subject to large errors".

Overall then this discussion highlights the key point of all this: the importance of methodological testing in foraging studies of waders, and perhaps also the complexity of developing a good experimental design. I hope that our discussion will encourage more wader researchers to devise similar methodological tests for their own studies, and to report their results on a topic that is as yet poorly covered by published literature.

REFERENCES

Cayford,J.T. 1988. A field test of the accuracy of estimating prey size selection in Oystercatchers from recovered mussel shells. *Wader Study Group Bull.* 54: 29-32.

Speakman,J.R. 1984. The energetics of foraging in wading birds (Charadrii). PhD Thesis, University of Stirling, Scotland.

Speakman,J.R. 1990. Bias in the collection of mussel shells opened by Oystercatchers. *Wader Study Group Bull.* 58.

J.T.Cayford, RSPB, The Lodge, Sandy, Beds. SG19 2DL, UK

NEW WORLD SECTION

EDITORS

P.W. Hicklin, Canadian Wildlife Service, PO Box 1590, Sackville, New Brunswick, E0A 3C0, CANADA

G. Ruiz, Smithsonian Environmental Research Center, PO Box 28, Edgewater, Maryland 21037-0028, USA

WHEN DOES THE WILLET 'PLOUGH' THE WATER TO CATCH FISH?

R.McNeil & J.R.Rodriguez

McNeil, R. & J.R. Rodríguez S. 1990. When does the Willet 'plough' the water to catch fish? *Wader Study Group Bull* 58: 50-51.

When feeding in turbid water in the Unare Lagoon, Venezuela, we observed Willets *Catatrophorus semipalmatus* feeding by 'ploughing' through the water with a partly opened bill. The birds were seen to catch small fish. The 'ploughing' technique may be used when poor visibility prevents visual feeding.

Raymond McNeil, Département de Sciences biologiques, Université de Montréal, C.P. 6128, Succ. "A", Montréal, Québec, Canada H3C 3J7
José Ramón Rodríguez S., Departamento de Biología, Universidad de Oriente, Cumaná, Sucre, Venezuela

On 20 March 1987, while censusing shorebirds and other waterbirds of the Unare Lagoon, State of Anzoategui, northern Venezuela, we observed 15 solitary Willets *Catoptrophorus semipalmatus* from the road which runs for 22 km that runs on the sand bar separating the lagoon from the Caribbean Sea. Only five Willets were seen feeding, but all five fed in the same way: they ran along the shore in shallow water (6-10 cm deep, generally above the tibiotarsal-tarsometatarsal joint), covering distances of 5 to 15 m in a straight forward rush, sometimes in zigzag movements, cutting the water with their partly open bill, half-length under water (Figure 1a). Occasionally, the whole bill and/or much of the head was submerged (Figure 1b). Sometimes a rush ended with the bird moving to rest on the shore or moving to another nearby zone where the same behaviour started again, but on other occasions it ended with the bird catching a small fish almost as long as the bird's bill. On each occasion the Willet brought the fish on the wet sandy shore (above water line) and swallowed it after multiple pecks and shakes, apparently to kill it. We saw a Willet catching and swallowing three fish in the same way in an interval of 15 minutes.

Willets generally feed on small crabs, marine

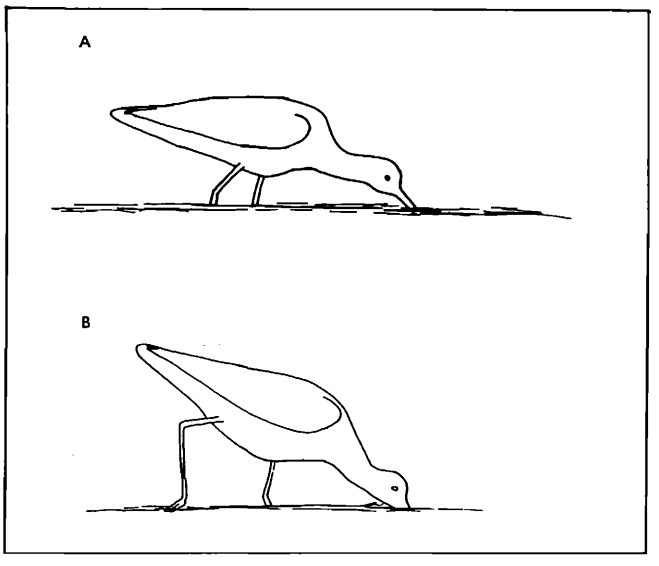

Figure 1. Willets 'ploughing' the water while running for feeding on fish (drawn from photographs).

worms, small molluscs, and aquatic insects (unpubl. data) when wintering in tropical lagoons or estuaries along coastal Venezuela. Normally, they are sight feeders that peck for their prey while walking, or touch feeders probing through soft sediments or liquid mud. It is not unusual, however, to find them feeding on fish fry and small fish (Bent 1929). The unusual way they were catching fish in Unare Lagoon resembles a method observed by Stenzel *et al.* (1976) in Willets feeding in Bolinas Lagoon (California). There sometimes Willets foraging in water up to their tibio-tarsi ran erratically and pecked in the water, obtaining by this method small unidentified prey and occasionally fish. The birds of the Unare Lagoon were, however, not pecking but instead were feeding tactily.

The pushing of the bill through the water in plough-like fashion, with the neck extended, has been reported for Greater Yellowlegs *Tringa melanoleuca* (Rowan 1929, Zusi 1968) and the Greenshank *Tringa nebularia* (Witherby *et al.* 1940, Lacey 1944, Cramp & Simmons 1983). These behaviours ranged from 'ploughing' with 1) the lower jaw only submerged, 2) the bill submerged, 3) much of the head submerged, to 4) the whole bird except the tail submerged. This last behaviour has been reported only for the Greenshank (Lacey 1944). The feeding method we are describing for the Willet is very similar to behaviours 2) and 3).

Zusi (1968) thought his birds were using visible surface ripples as an indication of the presence of fish to direct the ploughing or skimming in areas of fish concentrations; we had no such evidence for the Willet. On one occasion when the yellowlegs were engaged in ploughing with much of the head submerged, Zusi judged that the birds might be following schools of fish by sight because of their abrupt turns. This was in clear water, whereas the water of the Unare lagoon was extremely muddy with the color and turbidity of white coffee. This turbidity was caused by the discharge into the lagoon of surplus irrigation waters from the Unare River. The water level was extremely high so that the intertidal zone where crabs' holes normally occur was submerged. Zusi's yellowlegs also, in two occasions out of three, were foraging in muddy, turbid waters. It seems likely that Willets, and possibly Greater Yellowlegs, were unable to locate their prey by sight through too turbid waters and so had to rely on chance contact with prey by ploughing or cutting the water with their bill.

Wind and wave action, by stirring up sediments, may also increase water turbidity and reduce the visual detection of prey. As a consequence, Black-necked Stilts *Himantopus mexicanus*, which are predominantly sight-feeders during daylight, switch to a tactile feeding method (head immersion) when foraging on windy conditions (McNeil & Robert 1988, Robert & McNeil 1989).

This study is part of ecological research supported by the Natural Sciences and Engineering Research Council of Canada, the World Wildlife Fund (Canada), the "Fonds F.C.A.R." (Gouvernement du Québec), the Université de Montréal, and the Universidad de Oriente.

REFERENCES

Bent,A.C. 1929. Life histories of North American shore birds. Part 2. *U.S. Nat. Mus. Bull.* 146, Washington, D.C.

Cramp,S. & Simmons,K.E.L. (eds.) 1983. *Handbook of the birds of Europe, the Middle East and North Africa. The birds of the Western Palearctic*, Vol.3. Oxford Univ. Press, Oxford.

Lacey,G.I. 1944. Greenshank's mode of feeding. *British Birds* 37: 217.

McNeil,R. & Robert,R. 1988. Nocturnal feeding strategies of some shorebird species in a tropical environment. *Acta XIX Congr. Int. Ornithol.* (1986): 2328-2336.

Robert,M. & McNeil,R. 1989. Comparative day and night feeding strategies of shorebird species in a tropical environment. *Ibis* 131: 69-79.

Rowan,W. 1929. Notes on Alberta waders included on the British list. *British Birds* 23: 2-17.

Stenzel,L.E., Huber,H.R. & Page,G.W. 1976. Feeding behaviour and diet of the Long-billed Curlew and Willet. *Wilson Bull.* 88: 314-332.

Witherby,H.F., Jourdain,F.C.R., Ticehurst,N.F. & Tucker,B.W. 1940. *The Handbook of British birds.* H. F. & G. Witherby Ltd., London.

Zusi,R.L. 1968. "Ploughing" for fish by the Greater Yellowlegs. *Wilson Bull.* 80: 491-492.