Water sources of the Long-billed Marsh Wren in Georgia salt marshes.—Several species of birds live in coastal salt marshes and rarely have access to fresh water except during heavy rainstorms. T. J. Cade and G. A. Bartholomew (*Physiol. Zool.*, 32: 230–238, 1959) and T. L. Poulson and Bartholomew (*Physiol. Zool.*, 35: 109–119, 1962) have shown that two races of Savannah Sparrows, *Passerculus sandwichensis rostratus* and *P. s. beldingi*, which live in western salt marshes, can drink full-strength sea water. The salt marsh races of the Song Sparrow, *Melospiza melodia*, in the San Francisco Bay region of California can drink the brackish waters of that area (Bartholomew and Cade, *Auk*, 80: 504–539, 1963). However, very few of the terrestrial species that have been studied are able to drink sea water or estuarine water (Bartholomew and Cade, *op. cit.*: 518).

The Long-billed Marsh Wren (*Telmatodytes palustris griseus*) is a permanent resident in the vast salt marshes extending from the coast of South Carolina to northern Florida. During the breeding season it is found only in the tall marsh grass (*Spartina alterniflora*) which grows in the intertidal zone along the creeks and sounds between the mainland and the sea islands. The salinity in the estuaries varies considerably with the tidal stage and river flow, but averages 1.8 to 2.0 per cent throughout most of the creeks and sounds. In this area, fresh water is rarely found, except after heavy rains. The *Spartina* becomes wet with dew, in the early morning throughout late spring and the summer, but the drops are extremely salty. This is a result of active excretion of salt by cells located throughout the plant (K. Webb, pers. comm.). After the dew has evaporated, numerous crystals of salt coat the surfaces of the leaves.

During an earlier study on other aspects of *T. p. griseus* (Kale, *Publs. Nuttall Orn. Club*, no. 5, 1965), I conducted several experiments to ascertain whether these wrens can use the estuarine water as a water source. The results, although preliminary in nature, are presented herewith.

I kept several adult marsh wrens, which had been hand-reared from a pre-fledgling age, in separate cages. They were provided at different times with estuarine water or with fresh water (both ad libitum), or with no water. At all other times they were given fresh water ad libitum. It was impossible to measure the water consumption because the wrens pull water out of the drinking tubes with their bills and sprinkle it on their feathers.

Each wren was provided daily with several grams of meal worm larvae (*Tenebrio molitor*) and several grams of pellets of a specially prepared mixture (a moist mixture of fish, usually mullet, ground beef, and liver [1 : 1 : 1], Growena wild game bird food, and Pablum). The dry weights of several samples of these foods were determined by oven-drying at 100°C and vacuum-drying at 40°C. The meal worm larvae were 58 to 65 per cent water by weight, and the mixture, 45 to 49 per cent. In most experimental cases no special effort was made to determine the exact weight of the food consumed, although this was calculated in one instance and estimated in some others. The wrens on fresh water, however, were being used in feeding experiments and thus food weight data were regularly determined.

The weight changes of these experimental birds are given in Table 1. There was no significant change in weight, regardless of the water regimen. One individual that was deprived of water lost 0.95 g. However, such a loss over one week was not considered to be detrimental to the health of the bird. Wren no. 98, after less than three days on estuarine water, was found in a weakened condition. He had lost over 2 g and I found that his left eye was injured. The eye was sunk in its orbit and the bird was blind in that eye. The wren recovered rapidly after being

TABLE 1

WEIGHT CHANGES OF SALT-MARSH WRENS ON VARIOUS WATER REGIMENS

Bird	Length of experiment (days)	Weight (g)			Mean daily food intake (g wet wt.)	
		Initial	Final	Change	Meal worms	Mixture
			Fresh water			
85 ♂	7	9.74	9.76	+0.02	2.99	1.52
98 ♂	8	9.02	9.04	+0.02	2.40	1.43
92 ♂	7	10.07	9.96	−0.11	2.17	2.45
84 ♂	7	9.40	9.36	−0.04	2.52	2.54
91 ♀	7	9.38	9.45	+0.07	—	—
			Estuarine water			
91 ♀	10	9.46	9.92	+0.46	4.0[1]	<1.0[1]
92 ♂	7	9.76	9.81	+0.05	4.0[1]	<1.0[1]
91 ♀	7	9.45	9.37	−0.08	—	—
92 ♂	7	11.60	11.42	−0.18	—	—
			Water deprivation			
84 ♂	7	9.41	9.82	+0.41	4.0[1]	<1.0[1]
91 ♀	7	8.95	8.91	+0.04	4.0[1]	<1.0[1]
85 ♂	7	10.98	10.03	−0.95	3.23	1.44

[1] Estimates only, because food intake was not being measured; however, the mixture was rarely eaten.

returned to fresh water, but it was several weeks before he was observed taking a bath. Sight was never regained in the left eye. I do not know if the eye injury and loss of weight were a result of the salt water regimen, were aggravated by it, or were merely coincidental.

There was a change in feeding behavior in the wrens provided with estuarine water and those deprived of water. Both groups stopped eating the wren mixture, and increased their consumption of meal worms. Wrens provided with estuarine water continued to bathe several times daily, as usual. Wrens deprived of water became greatly agitated when they saw other wrens bathing.

When drinking, Long-billed Marsh Wrens peck or jab at the water and move or roll their tongues about. Wrens provided with fresh water often pecked at the water, but wrens on estuarine water rarely pecked at the water except when a fresh supply was presented to them. After several initial pecks, this activity would cease and rarely occurred thereafter.

Although these results do not prove that salt-marsh wrens do not drink estuarine water in nature (analyses of the plasma and urine would be necessary to determine this), the evidence strongly suggests that they do not. Also, the extremely small size of the nasal gland in these birds suggests that it does not play an important role, if any, in salt excretion. (Dr. George Bernard, who examined the nasal glands of several *T. p. griseus* for me, writes [*in litt.*]: "The gland is . . . ca. 5.5 mm long and about 1.78 mm wide . . . with a maximum cross-sectional diameter of 0.2 mm, thus the total mass of the organ is small. The gland apparently functions, but the duct system, vascular anatomy, and nerve supply remain to be worked out.")

Thus, the only source of water for this salt-marsh wren, if it does not or cannot drink estuarine water, must be either metabolic water or water from its natural food. The former seems highly unlikely (see Bartholomew and Cade, *op. cit.*: 507–509).

It appears that the experimental wrens provided with estuarine water and those deprived of water were able to maintain body weight by eating more of the food that was high in water content and less or none of the food that was low in water content. Wrens provided with fresh water were able to consume the drier food. Water content of salt-marsh insects and spiders that are eaten by *T. p. griseus* (Kale, *Oriole*, 29: 47–61) ranges from 55 to 70 per cent of the wet weight, which is similar to that of the meal worms fed in the experiments.

Thus, the Long-billed Marsh Wren in this salt-marsh habitat, apparently follows the ecological pattern of water economy which is characteristic of insectivorous birds living in arid regions, i.e., that of obtaining all the water needed from highly succulent food (Bartholomew and Cade, *op. cit.*: 526).

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Records of four species of *Pterodroma* from the central Pacific Ocean.—The Pacific Ocean Biological Survey Program of the Smithsonian Institution is currently conducting ornithological investigations in the central Pacific Ocean. This paper summarizes specimen and observational data obtained by this program on four relatively little-known members of the procellariiform genus *Pterodroma*: Murphy's Petrel (*P. ultima*), Tahiti Petrel (*P. rostrata*), Kermadec Petrel (*P. neglecta*), and South Trinidad Petrel (*P. arminjoniana*). Observations and collections made between August, 1963, and March, 1967, in the 3.33-million square mile area between 0° and 25° North latitude and 148° West and 175° East longitude are covered. Specimens reported here are in the collection of the U. S. National Museum.

Pterodroma ultima.—A female (USNM 492988) was taken by James Ludwig on Green Island, Kure Atoll, Leeward Hawaiian Islands, on 7 October 1963. It weighed 405.2 g; the largest follicle measured 2 mm. The bird was noted in the morning, flying low over the vegetation and calling. A female (USNM 497224) was taken by Brian Harrington on Tern Island, French Frigate Shoals, Leeward Hawaiian Islands, on 9 September 1966. The ovary measured 20×4 mm; the largest ovum measured 4 mm. The bird landed several times on the island before it was collected.

This species had not been collected previously away from its breeding grounds in the Austral and southern Tuamotu islands. Possible confusion with similar species, such as dark-phased Kermadec or South Trinidad petrels, makes identification at a distance often unreliable. Few individuals of this or similar species were seen in the north-central Pacific. These birds were probably stragglers outside their normal range.

Pterodroma rostrata rostrata.—On 21 November 1964, Kenneth Amerman took a female (USNM 494097), at sea at 3°50'N, 178°09'W. It weighed 307 g and the ovary measured 7×4 mm. Six other individuals resembling this species were observed on the same day. A male (USNM 495269) was taken at sea by Dayle Husted at 6°21'N, 156°04'W on 11 June 1965. It weighed 451 g; the testes measured 6×5 and 9×7 mm. The bird was flying with a similar bird and 10 other individuals