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TRAPPING AND MAINTAINING SHORE BIRDS IN CAPTIVITY

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INTRODUCTION

Because so much remains to be learned even empirically about the migration of shore birds and because they also offer important possibilities for physiologic research on transequatorial migration, we feel that it may be useful to communicate our experiences with trapping and maintaining several species in captivity.

In October 1958 we began trapping operations on the Swan River estuary at Perth, Western Australia, to obtain live birds for experimental investigations. Large numbers of Palaearctic-breeding sandpipers and dotterels annually congregate on the estuary beaches during the southern hemisphere summer, arriving in late September and leaving again by mid-April. The tides in this area are slight and are of the daily type, with one high and one low water in each 24 hours. In the summer months low water is in the early mornings and the tidal range varies only from about 30 to 100 centimeters. The physical conditions are such that it appeared the estuary would be an ideal place to adopt the trapping technique described by Holgersen (1953: 148).

TRAPPING OPERATIONS

The site of the trapping station was the western shore of Pelican Point within a mile of our laboratory. This sandy promontory juts into the estuary at Melville Water; a fairly firm beach of muddy sand is backed by a sward of *Salicornia* and further inland with dense tussocks of *Juncus maritimus*.

The traps were constructed according to Holgersen and were of triangular form with a galvanized wire frame (14 gauge) covered with galvanized wire-netting of 18-millimeter (¾-inch) mesh. The sides of the traps were 105 centimeters (42 inches) long and 35 centimeters (14 inches) high. On two of the sides were funnel entrances, 22.5 centimeters wide and 17.5 centimeters high (9 x 7 inches). These were continued inwards for about 32.5 centimeters (13 inches) and their openings narrowed internally to about 15 centimeters (6 inches) wide and 10 centimeters (4 inches) high. A trap door was made in the roof to permit removal of the birds caught. As many as 21 traps were used simultaneously. They were arranged in batteries of three and four on floating masses of sea weed (*Gracilaria conferroides* and other species) or at "capes" in the meandering shore line, the line of traps being set normal to the shore line, partly in and partly out of the water.

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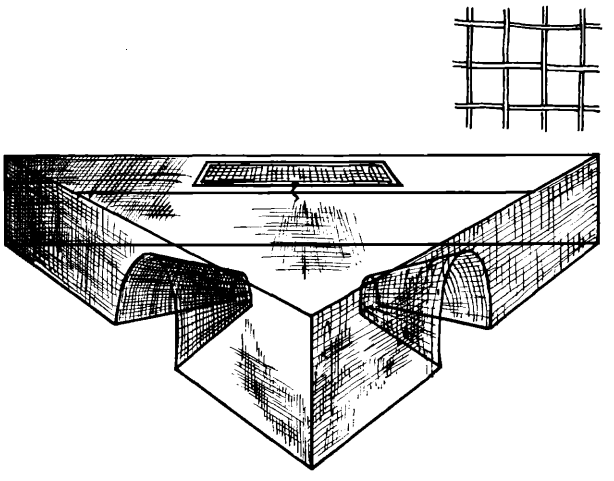

Figure 1. Diagram of Holgerson-type Trap for Shore Birds.

At first we also used low fences of galvanized wire netting as extensions to the trap line to "guide" the flocks of feeding birds to the traps, but these did not seem to materially increase the catches and soon became clogged up with drifting seaweed. Subsequently the traps were used alone and were set as illustrated in Fig. 2.

Our procedure was to put out the traps early in the morning, when the tide was out, and arranged the series at the then shore line. The tide would remain stationary for a few hours or advance very slowly during the forenoon. The traps were visited at about 2-hour intervals, the birds removed and the traps moved to adjust them to the new position of the tide line. At dusk the traps were taken up and stacked on the shore. Our earlier practice was to take them out to deeper water so that they would be in a catching position again at low tide in the early mornings. However it was found that the traps gathered so much drifting seaweed (of the slimy *Enteromorpha* type) when submerged overnight that the wire mesh became fouled and too difficult to clean.

Traps of the size described and with an entrance opening of 22.5 x 17.5 centimeters (9 x 7 inches) were ideal for the capture of the smaller and medium sized shore birds, up to the size of Sharp-tailed (*Erolia acuminata*) and Pectoral (*E. melanotos*) sandpipers. Very occasionally a Black-bellied

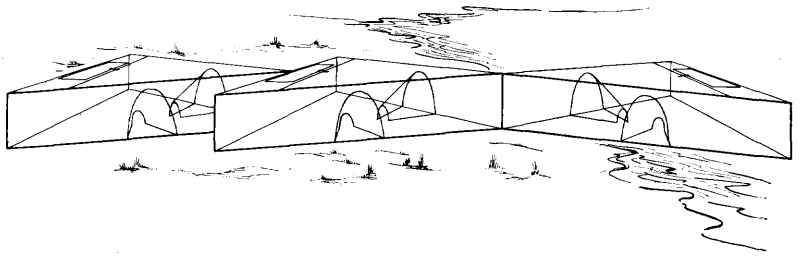

Figure 2. A Commonly Used Arrangement for Trapping Shore Birds.

Plover (*Charadrius squatarola*) would be caught and sometimes the small Australian Grey Teal (*Anas gibberifrons*) would crowd into the traps. However, for birds of this size, and also for godwits (*Limosa limosa* and *L. lapponica*), which ocasionally frequented the Point, the trap openings were apparently too small.

During the season 1958-59 we had 12 traps almost continuously in operation from 30 October to 20 April. During the 1959-60 season 21 traps were in use between 27 September and 20 April. Laboratory staff members attended the traps during the week and we were assisted during weekends and holidays by volunteer teams of amateur ornithologists. The numbers of birds caught by the traps during the two seasons are recorded in Table 1.

TABLE 1
Resumé of Trapping at Pelican Point
During Two Seasons

Species	Season 1958-59	Season 1959-60
Erolia ruficollis	245	487
Erolia testacea	28	78
Erolia acuminata	108	266
Erolia melanotos	0	1
Calidris tenuirostris	1	0
Arenaria interpres	0	1
Charadrius ruficapillus	53	55
Charadrius leschenaultii	0	2
Charadrius dominica	4	2
Charadrius squatarola	0	1
Erythrogonys cinctus	0	1
Larus novae-hollandiae		2
Sterna nereis	0	1
Anas gibberifrons	20	0
Anthus novae-seelandiae	0	1
Totals	459	900

After removal, the birds were taken to the laboratory in hooded holding cages. Here they were banded, weighed, and notes on molt and plumage were recorded. Some of the individuals of the first three species in Table 1 were held in experimental cages at the laboratory; the remainder were returned to Pelican Point and released. Birds captured late in the evening were usually held overnight at the laboratory and released early the next morning.

It was found that the best catches were made in the forenoon. The following summary shows the temporal distribution of the catches of shore birds during the 1959-60 season by 2-hour intervals:

Time of day	*Numbers trapped*
0700-0900	216
0900-1100	262
1100-1300	149
1300-1500	148
1500-1700	125
Total	900

As the afternoon sea breezes strengthened most of the birds would disperse elsewhere in the estuary. At times in strong wind the birds would congregate in the lee of the traps and wander in. "Heat wave" conditions, with no wind, appeared to be optimal for trapping. The summer of 1959-60 was unusually cool and the high catches at the end of December and beginning of January (Fig. 4) coincided with the only period of sustained hot weather experienced during that season.

Special local conditions contribute to the capture of particular species. Sharp-tailed Sandpipers prefer wading in 2-5 centimeters (1-2 inches) of water over soft mud and on partially submerged masses of sloppy seaweed (*Gracilaria confervoides* and other species). Little Stints favor similar situations but feed on the shore line itself, and the damp weed beds left behind by the receding tide. Curlew Sandpipers occur generally. The Red-capped Dotterels prefer the damp areas well behind the shore line, or miniature lakes left by the tide; they definitely frequent a drier situation than the other shore birds. Human tracks, to and from the traps, often led to the capture of many birds. Curlew Sandpipers particularly, tended to prod along these wet mud tracks. The lines of tracks would attract scattered birds and concentrate them to the neighborhood of the traps. This method failed in a sandy terrain and tracks over sandy mud seemed to offer no attraction to the birds. The traps would be set wherever the majority of shore birds, at the time, were congregated.

MAINTENANCE OF SHORE BIRDS IN CAPTIVITY

Species and Enclosures

Sharp-tailed Sandpipers (*Erolia acuminata*), Curlew Sandpipers (*E. testacea*) and Little Stints (*E. ruficollis*) were held in captivity in large outdoor aviaries, about 3 meters (9 feet) high 2.5 meters (8 feet) square. Two of the walls were of solid construction, whitewashed on the inside and the other walls were of chicken netting. The roof was of corrugated iron. The earthen floors were covered with beach sand which was changed at regular intervals.

The maximum number of birds in each cage at any one time was 40. The maximum period during which they were held in captivity was 6 months, at which point the experiments were terminated.

Temperature

The maximum temperatures to which the captives were subjected in the cages varied from about 21° to 35° C (70° to 95° F) in the summer months and the minimum temperatures fell at night to between 11° and 18° C (51° and 65° F). In April and May, at the close of the experiments, the maximum temperatures by day ranged between 21° and 29° C (70° and 84° F), and the night minimum temperatures to between 6° and 14° C (45° and 57° F).

As cold weather approached the outdoor enclosures were warmed by the following heating arrangement. Two 100 watt light bulbs were led into a cavity in the floor and covered with a metal drum 75 x 30 centimeters (30 x 12 inches) turned upside down over them and buried in the ground. A thin film of earth was heaped over the drum. The birds stood over this at night in the cold weather.

Social Behavior

Some aspects of social behavior in the Sharp-tailed Sandpipers appeared to have an effect on the well-being of some individuals when kept in captivity and it seems impracticable to cope with this effectively. One bird almost invariably assumed dominance over the others and controlled their access to both the feeding and water trays. If there were more than about twelve birds in the enclosure there would be two such "despotic" or dominant birds, one at each tray. If there were less birds one despot was able to dominate both of the trays simultaneously. This it would do by herding the other birds into a neutral corner (where there was neither perch nor tray) and keeping them there by walking in a crouched position backwards and forwards across the corner, with feathers ruffled, legs bent and uttering a *"cheek, cheek, cheek"* note. Birds that broke away would be driven back to the corner by pecking and beating with the wings. This would occasionally cause the attacked bird to fall down, whereupon the attacker would jump on the victim and beat it up. Two birds were killed in this way before the attacker could be restrained.

After several weeks of captivity physical violence gave way to a more stylized aggression, in the form of docile sparring. The dominant bird would take up a stand beside the food and water trays and endeavor to keep others away by making crouched runs at any intruders. There was very seldom any pecking or beating with the wings, but occasionally when a sandpiper would call the attacker's bluff, fighting would be resorted to. It was usually a show of fight, however, and rarely would aggressive posturings lead to actual conflict. The birds during these maneuvers would run forward and backwards with equal facility. Much of this behavior would soon have an exhausting effect and the birds would generally sit on the ground for a moment or so to recover, or perhaps break off the engagement entirely. A graded social hierarchy existed, the net result of which was that birds low in the order appeared to have difficulty in obtaining adequate food and were compelled to bathe in water trays somewhat fouled by previous use.

Water Requirements

Trays of both sea water and fresh water were provided in the enclosures, the depth of water being about 5 centimeters (2 inches) or less. Bathing was frequent but only when the water was cool and clean after replenishment during the mornings. The large bowls were dispensed with when the cold weather set in, as the birds would soak themselves at their morning bath and then stand shivering, the weaker individuals failing to preen or dry themselves sufficiently. Small bowls were introduced which allowed water to be used only for drinking, and in place of bathing the birds were sprayed daily with a hose. Spraying appears to have the advantage over bathing as all the individuals are washed with clean water. The last individuals to use a tray after the majority have bathed are forced to use greasy, usually sandy, water.

Shore birds drink large amounts of water daily, and fresh water is preferred. During a 24-hour period, 12 birds may drink more than 500 milliliters of water.

Very often a bird will go to the water bowl when hungry, not thirsty. It will probe for several minutes, apparently searching for food and, finding none, will look elsewhere. A thirsty bird drinking water lifts its head to swallow a large amount at once.

Food and Feeding

All food, with the exception of an occasional snack of meal worms and fly larvae, was given to the birds in shallow galvanized iron trays, 75 x 37.5 x 2.5 centimeters (30 x 15 x 1 inches). The birds fed readily from these and showed no unfavorable reaction to the feeling of the metal either on their feet or beaks. The birds, however, would probe with great avidity in the damp earth when it was newly laid on the floor of the cages and were agile in capturing larvae and other live prey offered to them from among the floor debris. From observations made during the treatment of sick birds (to be described in greater detail later) it would appear that the birds might with advantage be given their food submerged in the water in the feeding trays.

The food offered to the birds was porridge (crushed oats), powdered milk, bread, raw chopped beef, raw chopped liver, and chopped fillet of raw fish of several marine species (particularly *Mugil dobula, Arripis georgianus, Pomatomus saltator* and occasionally Coridae). Chopped raw liver was preferred by the birds to anything else and, almost without exception, was always entirely consumed. Meal worms also were always acceptable but unfortunately our cultures of these were never sufficiently successful to provide adequate meals. Whole earthworms were not readily taken but were eaten when chopped.

A quantitative estimate was attempted of the food eaten per day during the 1958-59 experiments by weighing the food before and after the birds had fed. Exact assessments were not possible, but with a mixed fish and liver diet it was calculated that Sharp-tailed Sandpipers ate 18 grams per bird per day and Little Stints from 11 to 15 grams so the percentage of food eaten daily per body weight was, respectively, 28 percent, and 42 percent to 58 percent.

Potassium iodide was added to fish so that each bird received about 0.2 milligrams per day. This treatment was given as a preventive against aspergillosis of which we had no cases during our experiments.

A vitamin additive (in the form of a proprietary preparation known as ABDEC Drops, in aqueous solution) was added daily to the fish (one drop per bird per day). Later we used another proprietary preparation, Vitamol, a vitaminized oil for animal use.

During the 1958-59 season a small tray of table salt was kept before the birds, but apparently little notice was taken of it.

In our experiments of 1959-60 in the second season we decided not to continue with the Little Stints owing to mechanical problems of preparing their food into sufficiently small particles so that the birds could ingest them. The gapes of these small sandpipers are so small that even meal worms are too large for them.

During both seasons it became evident that something was lacking in the diet being offered to the birds. In 1960 we added live woodlice or slaters (oniscid isopods) to the diet, as an approximate substitute for their normal food. Ample supplies were forthcoming from the public following appeals in the press. These were given to the Sharp-tailed Sandpipers and the birds ate them freely. There is no doubt that they contributed to the success in keeping the birds in captivity but it is felt that the problem of maintaining shore birds in captivity has not yet been solved completely and that dietary problems still have to be overcome. In the following section we discuss in more detail the difficulties which we encountered.

Dietary Deficiency in Captive Shore Birds

A number of the captive shore birds appeared to be suffering from a nutritional deficiency after a month or so of aviary life. Not all birds were so affected, and several became heavy with fat and remained in good condition.

The bodies of several Sharp-tailed Sandpipers which died in the aviaries were thoroughly examined by the Animal Health and Nutrition Laboratories of the Department of Agriculture. No infectious organism was located in any of the body tissues, and the condition therefore was attributed at least tentatively, to nutritional deficiency.

Diarrhea was the first symptom of malfunction in the bird, followed by gradual bodily emaciation coupled with hypertrophy of the liver. Affected birds became lethargic and ill-kempt, failing to bathe or preen sufficiently. Examination of enlarged livers disclosed great infiltration of fatty substance, a significant sign of malnutrition despite apparently adequate food.

Feathers became loose, and in some cases were shed, particularly from the body. Normal wing molt was retarded. The outer skin of the bill and legs of ailing birds peeled and flaked off, leaving tender areas prone to ulceration or injury. In the last stages of this deficiency disease, anemia developed and the bird debilitated. In a few cases eyesight was impaired and the eyes affected as though by conjunctivitis. Motor co-ordination became erratic in the final stages, ending in complete paralysis of the legs. The birds usually succumbed in a comatose state, lying on one side on the ground with the head arched over the back.

Treatment of Shore Birds with Nutritional Deficiency

Several severely affected Sharp-tailed Sandpipers and one Curlew Sandpiper in a coma, were taken from the aviaries and attended individually. Most of them, including the Curlew Sandpiper, completely recovered in approximately 7 weeks. Immediately upon rescue from the cage, a strong solution of warm glucose was force fed to the birds. For the first few days they were kept in an artificially heated cage. Paralyzed birds were held in a squatting position by padding and a head support was used to hold up the bill horizontally. Any wounds were dressed immediately, and raw bills and legs coated with Tincture of BenzCo and thus sealed. All sick birds were hand washed in warm water to which a detergent was added in order that the grease might be removed from the plumage, and the body heat subsequently regulated.

Until they were able to feed, the birds were force fed the following items in rotation: chopped earthworms; chopped slaters; sand hoppers; house flies; maggots; meal worms; fresh minced fish; fresh fish liver; small insects; meal worm cuticles stuffed with wet beach sand; and small amounts of sugar solution; honey and warm water; vitamin enriched fresh water; and salt water in which powdered cuttle bone was mixed. Shorebirds caught in the traps and decapitated for gonad inspection invariably had their stomachs full of sand. To ensure that sick birds, being force fed, received as natural a diet as possible, wet beach sand was stuffed into meal worm cuticles and given. Each bird received three 1/3″ cuticles of sand daily, one with the early morning meal, one at midday, and one in the evening. When they became able to feed, all feed was mixed with a little beach sand and covered by 1 centimeter vitaminized water with a pinch of iodized table salt per 25 milliliters of water. The birds much preferred

search under sandy water for feed than taking it from a dish. Water also helped to break up the food.

When they were able to walk about and feed, the birds were kept in an open-air run (ordinary black-soil ground) through which a small stream of water ran from a hose. Feed bowls were placed along this miniature water course, where the birds spent much time probing. They appeared not to like to probe in dry sand whereas feed bowls sunk in wet sand were accepted readily. They would probe along the wet sand, and then coming to the feed bowl and poking about in the sandy water therein, would consume the feed.

Only small amounts of feed were kept before the birds at any one time. Immediately after the bowl became nearly empty, a fresh meal was supplied. This involved changing feed bowls at 2-hour intervals. When sufficiently strong, each bird was taken at least once per week to the river foreshore, to bathe and forage for a few hours. During this time a large bowl of wet sand from the shore line was gathered and transported back to their run. For the rest of the day the birds were allowed to probe in this, and Sharp-tails were often observed pulling out 2-5 centimeter worms and earwigs and thrashing them on the ground to kill them before eating them. The Sharp-tails were also extraordinarily adept in catching fast moving sandhoppers.

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SEQUENCE OF MIGRATION, BY SEX, AGE, AND SPECIES, OF THRUSHES OF THE GENUS HYLOCICHLA, THROUGH CHIGAGO

By ORMSBY ANNAN

INTRODUCTION

The avian genus *Hylocichla* (family Turdidae) is regarded as composed of five species (A.O.U., 1957), although there are some ornithologists who favor transferring four of the species to the closely related genus *Catharus* (Ripley, 1952; Dilger, 1956). The five species are the wood thrush (*Hylocichla mustelina*), the hermit thrush (*H. guttata*), the Swainson's thrush (*H. ustulata*), the gray-cheeked thrush (*H. minima*), and the veery (*H. fuscescens*). Birds of each of these species migrate to or through the Chicago area. As part of a study of the regulation of timing

[1] The investigation, of which this paper is a product, of regulation of migration in thrushes of the genus *Hylocichla* was carried out at Northwestern University under the direction of Dr. Albert Wolfson, to whom grateful acknowledgement is made for his patient supervision and criticism, as well as for his assistance in making collections. For assistance in collecting I am also indebted to John T. Newell, III; Jack Palmer; Betty Annan; and Tom Kemper. Banding data were supplied in great quantity by Mr. Karl Bartel and Mr. Alfred Reuss, Jr., to whom I am deeply indebted