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Magratory birds Charadriidae and Scoloplacidae switch their diets with the change of natural resources in the Su Tsao Wild Life Reserve in Taiwan

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## Migratory birds Charadriidae and Scolopacidae switch their diets with the change of natural resources in the Su Tsao Wild Life Reserve in Taiwan

### Abstract

The Su Tsao Wild Life Reserve is a very important perching habitat in southwest Taiwan for migrant birds about 189 species in which Charadriidae and Scolopacidae are the most abundant birds. An area with high density birds during the migrant period were chosen as experimental sites from 2000 to 2001. From analyzing the gizzard contents of birds and comparing the invertebrate specimens in these areas and nearby, we suggested that both Charadriidae and Scolopacidae consumed the similar diets, which are the main benthos here, including the mollusks (*Thiara riqueti* and *Clithon retropictus*), polychaetes (*Neanthes glandicineta*), aquatic insects (Hydrophilidae) and the Diptera larvae and pupas. Statistic analysis presents that the diets of Charadriidae and Scolopacidae (except *Charadrius alexandrinus*) are limited in which the habitats can provide not by the food preferences of birds and no significant result support the effect of bird consuming to benthos and zooplanktons. In this study we also found that the salt pans are indeed rich in food resources for the migrant birds and *Charadrius alexandrinus* with special feeding behavior seemed to affect the prey item they consumed. No such correlation was observed between the abundances of birds and benthos.

### Introduction

Migrant birds are the international wildlives which fly across different countries. Taiwan between Asia and Australia is an intermittent station of the migrant birds, and the Su Tsao Wild Life Reserve at Tainan in southwest Taiwan was set up for conservation of migratory birds in 1997 for providing about 189 species migrant bird to perch. Charadriidae and Scolopacidae are the most abundant birds, there are more than ten thousands per day during the migrant period in this small area (Su, 1999). Most parts of the Su Tsao Wild Life Reserve are the saltpans, occupies about 73% area was closed out many years ago for coast sinking and now become the coexistence of the man-made and natural wetlands, others are the fishery culturing ponds and the estuaries. The Su Tsao Wild Life Reserve is a man-control region, which seawater cannot flow in and out naturally and freshwater only can enter in via the around ditches but cannot flow out in these isolated salt fields. Therefore, what kind of habitat will be needed to construct and maintain is the most important topic for the Su Tsao Wild Life Reserve.

Studies showed that diets of birds reflect availabilities of resources in the feeding habitat or the prey abundance (Shaffer and Laporte, 1994; Heinrich and Bell, 1995).

Gray(1993) and Lefebvre and Poulin(1996) also suggested that the temporally varied abundances or densities of birds correlated with the abundances of prey resources in habitats. We hoped to establish a place with abundant organisms as bird diets to gather large number of migrant birds. But we did not know what were the diets in this area to migratory birds, which was a very serious problem for no foundation information to make the management strategies.

This study tried to answer two questions: 1.what is the food resources of the main migratory bird Charadriidae and Scolopacidae? 2.what is the relationships between these birds and the food resources in this area? We hope the study results can provide the information to establish suitable plans for controlling and managing this wild-bird protected areas in supplying the enough and suitable diets of migratory birds.

### Materials and Methods

It was performed through the next procedures: 1.observing of feeding behavior in birds; 2.analyzing the stomach contents of birds; 3 collecting and comparing the specimens of zooplanktons and benthos in this area.

#### Sampling sites

The study was executed in a shoal of a closed lagoon, which is the main habitat for the feeding and resting of the migratory birds in the Su Tsao Wild Life Reserve Area

#### Sampling methods

##### Vomit collection:

Ten fog nets were set up and used to capture birds from dark to next morning. Birds were brought to work station in this Reserve Area and conducted the next experiments. Emetic way to collect food debris from their gizzards and stomachs. Inserting a baby catheter connected a syringe with saline and then forcing the saline to the stomach and gizzard of birds until birds spewing to the plastic bag. Birds were supplied with diluted dextrose for replacing original diets and stayed in dark boxes until next morning. The vomit in plastic bag was sluiced by 100% ethanol and filtered immediately. Filtered fragments were stored in 100% ethanol and brought to laboratory. We changed filtered fragments to 75% ethanol for permanence storage at laboratory.

##### Collection of possible diets of organisms in the field:

##### Collection of benthos (mainly in macrobenthos (size greater than 0.5mm)):

The macrobenthos is collected in 10cm depth by a plastic tube (10cm in diameter).

##### Collection of zooplanktons:

A drift net in 10X10cm<sup>2</sup> with 80  $\mu$  m will be towed 5 meters under the water surface to collect planktons.

#### Exclosure experiment:

Using an exclosure experiment to test the consuming effect of bird feeding to benthos. 5 rigid exclosure nets and 5 control exclosure nets were set at this experimental region. 2 X 2 m<sup>2</sup> in diameter and each net at a distance of 5 meters. Every month two random samples of benthos were collected by plastic tubes as described later in each exclosure nets. Benthos specimens were treated as described later.

#### Analysis method

Samples that could not be easily distinguished in the field were brought back and stored temporarily in 100% ethanol, then changed to 75% ethanol for permanent stock after returning to laboratory. Several good quality samples in each species were selected to record by photography. Small organisms were identified by microscope, and immersed in the glycerol until the body completely unfolded before identification or taking pictures.

The abundance and density of all organisms will be calculated, combined with the physical factors and recorded in Excel program. Species composition is analyzed by the Shannon-Wiener Index to study the diversity of different of aquatic organisms to show patterns in diversity at different sampling sites. Multiple ANOVA was used for testing the different consuming effects among each experiment sites. UPGMA clustering method is used to present the similarity of feeding diets of different bird species. From the Spearman correlation analysis to present what are the main environmental factors that affect the abundance of diet organisms, and what are the physical and biological factors that are related with bird feeding.

#### Results and discussion

##### Vomits of 86 birds successfully collected

Total 83 birds were caught and performed the emetic way to collect food debris from their gizzards and stomachs, including 7 species (*Calidris alpina*, *Calidris ruficollis*, *Calidris acuminata*, *Heteroscelus brevipes*, *Tringa nebularia*, *Tringa stagnatilis* and *Tringa tetanus*) in Scolopacidae and 4 species (*Charadrius alexandrinus*, *Charadrius mongolus*, and *Pluvialis fulva*) in Charadriidae. No birds were dead, hurt or feeble for this emetic way. It is present that this method is fast, easy, safe, cheap and suitable for many species of shorebirds.

##### Diets of 11 species birds no significant difference

11 species birds were caught and their emetic contents were analyzed. Mollusks (Potamidae and Neritidae), Polychaetes (Nereidae), crustaceans (*Uca* sp.), insects

(Diptera) and seeds are the frequently diets for these migratory birds. Few sands were found in the stomach contents, perhaps most birds ate the mollusks with shells that have the function as sands to grind not easy digested foods. The other hand is that some paper pointed that bird consume the mollusks with shells for supplying calcium for laying eggs (Graveland and Berends, 1997).

Results of UPGMA and the Shannon-Wiener Index showed that there were no differences among diet selections among different species. Benthos and zooplankton collections showed that there were more than 40 species invertebrates existing in this experimental area. Mollusks (Potamidae and Neritidae), Polychaetes (Nereidae), crustaceans (*Uca* sp.), insects (Diptera) were the most abundant animals in this experimental site and were high correlatedly with the organisms obtained from the emits of birds. It was suggested that diets of Charadriidae and Scoloplacidae are limited in which the habitats can provide not by the food preferences of birds.

Exclosure experiment can not prove the effect of bird consuming to benthos: Statistic analysis showed that 1. no significant difference in benthos abundances between the rigid and control net sets; 2. no significant difference in benthos abundances between each continued months; 3. no significant difference in total benthos numbers between rigid and control nets; 4. even test different species with former 3 analysis methods, there were still no difference between different data. Therefore, we suggested that exclosure experiment can not prove the effect of bird consuming to benthos in our study. The reasons are 1. there were no enough bird number to consume there for producing meaningful decreasing in benthos; 2. the interval between two collection times is too long for most benthos can move in and out easily during such long period time; 3. many birds fed water insects, but there is few of them in our collection for their quick mobile ability. According the former reasons, we will modify the original method to do the short period test of exclosure experiments for decrease those problems.

*Charadrius alexandrinus* more crabs and water insects than other bird species

Fast running and pecking simultaneously is the feeding character of *Charadrius alexandrinus*. From the diet analysis to present *Charadrius alexandrinus* consumed more crabs and water insects than other bird species. But from our collection data of environmental animals, the crabs and water insects are not the most abundant animals in experimental areas. It is suggested that special feeding behavior let *Charadrius alexandrinus* consume the animals they prefer not for the organisms that the environment can supply most.

The salt pan of Su Tsao Wild Life Reserve in Taiwan indeed exist enough organisms as food for migratory birds

The landforms of salt pans seem to be very simplex and unitary, high salt concentration of water in pans by evaporation, but salt pans still gathers such large number of waders to show that there must be rich in diet to birds for feeding, resting, and breeding. In our study, we confirm that the salt pans are very important perching habitats in the Su Tsao Wild Life Reserve in Taiwan for migrant birds. The most frequently found organisms at this experimental area in salt pan are the fishes (*Oreochromis hybrid*, *Poecilia velifera*, *Gambusia patuelis*, Family Gobiidae), the shrimp (*Acetes* sp.), the mollusk (*Thiara riqueti*), polychaetes (*Neanthes glandicincta*), aquatic insects (Hydrophilidae), and pupa and larva of Diptera. They can live in such severe environment with highly variable salt concentration, water depth and temperature.

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