Communal Roosting of Wintering Oriental White Storks *Ciconia boyciana* in Yonaguni Island, the Westernmost Japan

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Oriental White Storks *Ciconia boyciana* seem to have bred commonly in Japan, even in towns, in 19th century (BLAKISTON & FRYER 1878, NIWA 1882, KIYOSU 1932) but ceased breeding in the 1960s (IKEDA 1994) and at present only a small number are sometimes reported in winter in different districts from Hokkaido to Ryukyu Islands (OSJ 1974, HIGUCHI 1976, OGASAWARA & IZUMI 1977, FUJIMAKI 1988). The stork is an endangered species on the global scale and its world population is estimated just over 3,000 birds (DEL, HOYO et al. 1992). Past studies on this species were almost totally confined to its present status and general ecology (e.g. DYMIN & PANKIN 1975, CAO & XU 1983, FEI & WU 1983, ANDRONOV 1988) and breeding biology (VINTER 1978, FUJIMAKI et al. 1990). We still do not have much information on its ecology which is indispensable for effective conservation and reintroduction (e.g. IKEDA 1994) of this endangered species.

It was on 23 November 1993 that a flock of Oriental White Storks were witnessed by the local people in a shallow pool of paddy field at a southwestern part of Yonaguni Island. Yonaguni is a small (29 km²) and rather flat (highest peak: 231 m a.s.l.) island situated in Ryukyu Islands at 24°N, 123°E. A spinal chain of hills run west-east, fringed by a mosaic of tablelands and lowlands which drops into sea as cliffs at the coast. The hillside is covered with semi-tropical evergreen vegetation, and the tablelands and lowlands are mainly cultivated fields of sugarcane and paddy with pastures spreading mainly at the coastline. Paddy field often forms shallow pools during winter until the period of rice-planting in spring.

From the next day of appearance of the storks, we continued efforts of searching them and knew that the storks could be usually seen in Tarumai-valley, 500 m south of the first-sight location. The valley is a west-east long (c.a. 2.5 km) and north-south narrow (0.3-0.5 km) wet lowland (0-5 m a.s.l.) sandwiched between a cliff at the inland side of a seacoast tableland (50-60 m a.s.l.) and a hill (60 m a.s.l. at the top). Part of the wetland at Tarumai was paddy field supplying more than 20 shallow pools of various sizes ranging from 0.1 to 0.7 ha throughout the study period. The hillside was a mosaic of bushy area and pastures.

In the morning of 25 February we conducted a preliminary observation of storks from a point located at the top of the cliff of the seacoast tableland where all the storks in the valley could be watched easily. At the time we recorded nine storks; three and five in adjoining two pools A and B, respectively and another in a grassy marsh 700 m east of the pools. Main study started in the evening of 25 February. We visited the valley in late evening around sunset and early morning around sunrise, and searched it for storks from the observation point. We stayed at the point for various
Fig. 1. Roosting of Oriental White Storks in Tarumai-valley. Temporal changes in number of storks positioned in three different habitats of the valley are shown for four nights and the following mornings. Solid circles indicate the number of storks at the start and the end of each observation (or at a scan). Alphabets indicate individual pools.

When we arrived at the observation point at 18:40 on 25 February, we recorded a flock of eight storks in pool B. The flock size increased to nine around sunset while we were off the observation point. The nine storks stood still forming an aggregation (distance between individual birds was a few meters) at the central part of the pool, which continued until we stopped observation due to invisibility in darkness, with a slight shift of the position of each bird within the pool. Next morning at 07:15 just after sunrise, we rediscovered the nine storks in the valley, but unexpectedly in a pool different from that in the last evening. That was pool C 600 m
east of pool B. It suggested that the storks had moved from pool B to C in the twilight before we arrived at the valley in the morning. This event made us visit the valley around 06:30 while storks were invisible due to darkness in the following three mornings. As shown in Fig. 1 the pool they were recorded and the number of storks coincided completely between the evening and the following morning for three nights from 26 February to 1 March. It evidences that the storks spent the nights in shallow pools of Tarumai-valley, in other words formed a communal roost there. They formed an aggregation every night at the central part of the pool. The position of the roost, however, was not always the same between nights. For successive two nights from 26 to 28 February storks roosted in pool C but moved to pool B in the evening of 28 February. Unique features to the two pools, B and C, used as roost (and also to A) are that they were large (0.5-0.7 ha) pools with clear water. Other pools in the valley were not clear and most of them were smaller than these pools. An interesting aspect we found in this study was that the number of storks roosted in the valley was not the same between nights. In the night 25-26 February, nine storks and in the following three nights ten storks roosted in the valley. This suggests that part of the wintering storks were roosting out of Tarumai-valley.

Figure 1 also shows their dispersion from the roost in three of the four mornings. In 20 to 60 minutes of sunrise the earliest storks walked or flew out of the roost pool and started foraging in the hillside pasture or grassy marsh in the valley, and after about 20 minutes of the first bird most of the roosting storks left the pool and started active foraging. Foraging behavior was seen in the roost pool also, but their activity was very low in the pool. After 08:00 storks left the valley in different sized flocks of one (27 February), two (26, 27 February), three (26 February) and eight (28 February). Most of these flocks flew over the spinal hills of the island and were lost sight of.

This study demonstrated that Oriental White Storks wintering in Yonaguni Island roosted communally in shallow pools of paddy field in a wet lowland valley. A possible explanation of the choice of shallow pools of paddy field as roost habitat is related to safety against ground predators. Although shallow water in the pool does not completely prevent access of ground predators like wild dogs, it supplies alarm signals of the sound made by predators when moving in the shallow water. The underwater deep mud in paddy field will function as an effective drag on approaching predators, as was suggested by Kawamura (1975) for communal roosting of Hooded Cranes Grus monacha in the paddy field. The choice of large pools in the valley is consistent with the anti-predation tactic. The storks were aggregated in the central part of the pool. A larger pool will confirm a longer distance between roosting storks and ground predators when the latter start approach. The reason why pools with clear water were selected as roost are not clear. Although another large pool with muddy water was available, storks did not roost there during the study. But more sample sizes will be required to conclude on choice of pools with clear water.

This study supplied information also on foraging habitat of the stork. Other than grassy marsh that is recognized as its general foraging habitat in the breeding ground (Andronov & Artemova 1988, Fujimaki et al. 1990), it foraged much drier habitat of pastures. Foraging in the pasture has been witnessed by local bird watchers in other Ryukyu Islands (Sakiyama, pers. comm.). Tarumai is a unique area in the island in that it contains different kinds of habitats appropriate for roosting and foraging in a closed valley. It is also the place most distant from the largest town of the island and free from human disturbance. These features might have supplied the storks a good roosting site there.

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