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Utilization of Shallow Inshore Waters by Ariid Juveniles in Saiburi Estuary, Gulf of Thailand

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Abstract

Utilization of the coastal habitats of Saiburi estuary in Gulf of Thailand by ariid juveniles was studied to assess their ecological role to the fish in terms of spatial, temporal and diel variations. Monthly samplings of the fish were carried out between November 1997 and October 1998 at three stations using a beach seine (40m x 2.5m, 4mm stretched mesh). Utilization of the habitat by juveniles of Arius maculatus, A. sagor *and* A. venosus *differed.* Arius maculatus *was the most abundant (62.9%) while* A. venosus *was the lowest (5.6%). The highest total abundance occurred in November (28.4%) and lowest in October (0.7%). Studies on spatial variation showed a highest total density at Station B (79.5%) which was located in the central part of the Saiburi river mouth and the lowest at Station C (9.4%) which was located along a beach facing the sea. Diel utilization of habitat by* A. maculatus *was evidenced by its juveniles entering the area during the night and leaving by the morning. This study further confirms the important role of the shallow inshore waters of Saiburi estuary as a nursery ground for ariid juveniles.*

Key Words: Estuary, Ariidae, Juveniles, Saiburi estuary

Introduction

Estuarine systems are productive areas that provide foraging and protective habitats for many species of fishes and other marine fauna (Day et al, 1989), particularly their juvenile stages (William and Hare, 1998). Fishes of the family Ariidae (marine catfish), have long been known to inhabit the Saiburi estuary during some or all stages of their life history. They are commercially and recreationally important species throughout Southeast Asia, especially in southern Thailand and Malaysia. Commercial landings of fish by traditional fishermen in Thailand using gill nets, cast nets and by anglings are frequently found in local markets and sold at about 30-50 baht/kg (US$1 = 36 baht). In Malaysia, they also contribute to a sizeable portion of the marine fish landings (Harinder and Sasikumar, 1994).

However, scientific information regarding the ecology of the fish especially their juveniles are scantly. Little attentions were given to this particular resource. Despite that a few surveys conducted in Saiburi river and adjacent areas have overlooked the presence of ariid species (Benchamaparinyakul and Kunline, 1995; Kunline et al, 1995), local residents have long realized that they did present and played an important role as dominant species in the area. Angsupanich and Aruga (1994) reported three species of ariids collected in Songkhla Lake, Thailand. Harinder and Sasikumar (1994) reported five species of ariids from the Matang mangrove in Malaysia.

Temporal, spatial and diel variations are important aspects for studying the community structure of fish in wetlands (Sale and Douglas, 1984; Helfman, 1981). Such fundamental information is needed for proper coastal resource management. This study was conducted aiming at a better understanding of the ecological role of shallow coastal habitats to ariid juveniles. The Saiburi estuary, Gulf of Thailand is representative of tropical estuaries.

Materials and Methods

Study site

The Saiburi estuary, Gulf of Thailand (Figure 1) is located at the mouth of the 184-km-long Saiburi river. Two distinct monsoons; the Northeast Monsoon from November to March and the Southwest Monsoon from April to October influence the estuary. During the Northeast Monsoon, strong winds and high waves sweep the area, particularly between December and January. Conditions of the estuary are calm during the Southwest Monsoon. Three survey stations were selected based on differences in bottom substrates and water salinities to study utilization by ariid juveniles. Station A was located approximately 1 km inside the river mouth. It is characterized by a sandy-mud bottom with an average depth of 0.5-2m during low tides. The station is influenced by fresh water from Saiburi river. Station B was located in the central part of the river mouth and it has a sandy bottom with a depth of 1-3m during low tides. Station C was located along the beach facing the sea, approximately 500m away from Station B, with a sandy bottom and a depth of 0.5-2m at low tides. Station C was influenced by seawater from the Gulf of Thailand. Samplings were made from three substations within each station.

Collection of ariids and measurement of water quality

Ariids were collected monthly between November 1997 to October 1998. During each monthly sampling, 36 seine hauls were made over a 24h period. Sampling began in the late morning of the first day and continued until early morning of the second day according to the following schedule: (1) 1100-1300hrs; (2) 1600-1800hrs; (3) 2100-2300hrs; and (4) 0600-0800hrs. At each period, fish collections were conducted at all substations which served as replicates for each station with a 40-m knotless-beach seine (stretch mesh: 4mm). During operation, the net was deployed in a semicircle by a paddleboat and pulled manually to the shore. The sampling area was approximately $255m^2$ per haul. The samples were then sorted, identified to species and counted before preserving in 7% buffer formalin. In the laboratory, juveniles were measured for total length (TL) to the nearest 0.1cm. Surface water temperature and salinity were recorded in situ to degree C and ppt, respectively, using a SCT meter (YSI model 33).

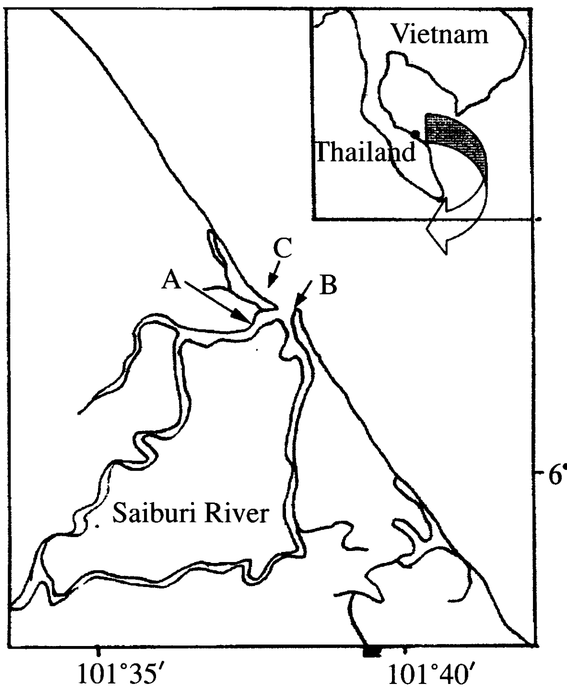

Figure 1. Study site

Statistical Analysis

Because the catch data contained large numbers of zeros, the total numbers of juveniles collected were then transformed as $\log_{10}$ (catch+0.1) to satisfy the assumption of normality. Analysis of variance (ANOVA) was performed to compare differences of habitat utilization dielly, temporally and spatially based on log-transformed data. Description was conducted based on relative abundance and its correlation to water quality.

Results

Water temperatures and salinities

Monthly changes in surface water salinity and temperature at the three sampling stations are shown in Figures 2 and 3, respectively. At Station A, salinity ranged from 0 ppt during the months of November, December, January and February to 10 ppt in May while water temperatures varied within 28°C to 32°C. At Station B, salinity ranged from 2 ppt in December to 25 ppt in May and water temperature from 28oC to 32oC. Higher

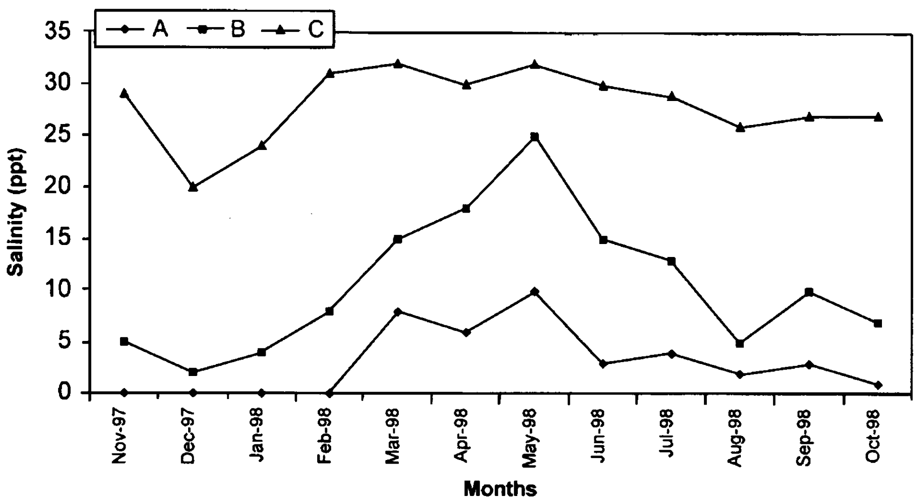

Figure 2. Monthly surface water salinities at three stations in Saiburi estuary, Gulf of Thailand

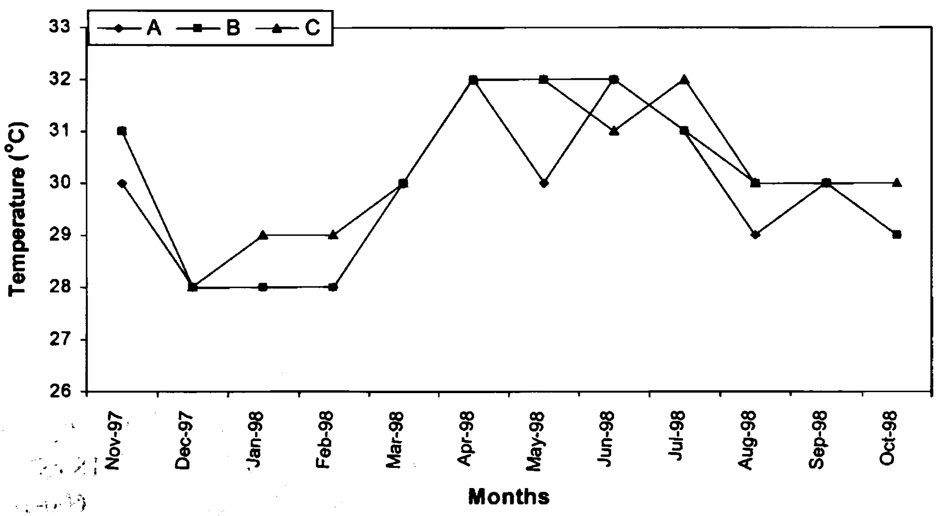

Figure 3. Monthly water temperatures at three stations in Saiburi estuary, Gulf of Thailand

salinity values were recorded at Station C ranging from 20 ppt in January to 32 ppt in March and May with water temperature ranging from 29oC to 32oC.

Overall distribution and abundance
Overall, 1,568 juveniles, accounted to be 6834 ind/ha, from three species, *Arius maculatus*, *A. sagor* and *A. venosus* were collected from the inshore waters of Saiburi estuary between November 1997 to October 1998. Fifteen adults of *A. maculatus* were also collected simultaneously. As the study was concentrated only on juvenile stages, all adults were then excluded. It was found that *A. maculatus* was the dominant species which accounted for 62.9% of total juveniles collected. *Arius sagor* and *A. venosus* have made up to 31.5% and 5.6% respectively, of total abundance. Average sizes of *A. maculatus, A. sagor* and *A. venosus* were 7.2cm, 8.5cm and 6.8cm, respectively.
Analysis of variance (ANOVA) on log-transformed data showed a variation of utilizing the habitat among the three stations ($P<0.05$) as well as among months ($P<0.05$). However, diel variations in juvenile densities appeared to fluctuate significantly ($P>0.05$).

Temporal variation
Apart from statistical evidence of the variation, relative catches showed two distinct seasonal peaks. The first was in November 1997 with 1943 ind/ha (28.4%) and secondly in March 1998 and April 1998 and with 1269 ind/ha and 1526 ind/ha (22.3%), respectively. The lowest value was recorded in August with only 78 ind/ha (0.7%) collected.
Temporal variation for each species was also recorded. The highest density for *A. maculatus* was occurred in November (62.9%) followed by April (31.4%) with the lowest (only 13ind/ha) in August. There were two phases of abundance for *A. maculatus:* peak during November through January and April and low during May through October and March.
Arius sagor was abundant between January to April showing the highest number occurred in March (1155ind/ha). Low numbers of the species occurred between May and December with the smallest number occurred in June when only 17ind/ha were collected.
Arius venosus, the least dominant species was present only for seven months between February and August with the highest number of 257ind/ha collected in February.

Spatial variation
A total of 5429 ind/ha (79.5%) were collected at Station B, 758ind/ha (11.1%) at station A and 645ind/ha (9.4%) at station C. Altogether, 3525ind/ha of *A. maculatus* (82.0%) was distributed at station B, 754ind/ha (17.5%) at station A and only 22ind/ha (0.5%) at station C. In case of *A. sagor*, 1834ind/ha (85.2%) were collected from station B, 314ind/ha (14.6%) from station C and only 4ind/ha from station A. While, *A. venosus* was not recorded from station A, but most of them found abundantly at station C (81.6%) and less so at station B (18.4%).

Diel variation
Relative abundance of the catch showed difference between time of day which 34.4% of juveniles were collected during 2100-2300hrs, 29.3% during 0600-0800hrs, 22.8% during 1100am-1300hrs and 13.4% during 1600-1800hrs.
This pattern is best illustrated by the most abundant species , *A. maculatus*. Altogether, 43.6% of this species were collected during 2100-2300hrs, with 29.5%, 16.7% and 10.2% collected during 0600-0800hrs, 1100-1300hrs and 1600-1800hrs, respectively. While *A. sagor*, 36.6% were collected during 1100-1300hrs, 28.7% during 0600-0800am, 18.6% during 2100-2300hrs and 16.0% during 1600-1800hrs, accordingly. The number of *A. venosus*

collected also varied among times with decreasing abundance across the periods of 1600-1800hrs, 0600-0800hrs, 2100-2300hrs and 1100-1300hrs.

Discussion

Subtropical and tropical estuaries have long been regarded as primary nursery grounds for many marine species (Day et al., 1981; Blaber et al., 1995). Finding from the study can be well supported that the shallow inshore water of Saiburi estuary is an important nursery ground for juveniles of ariids with each species having a different utilization pattern. Of the three ariid species, *A. maculatus* was the most abundant and the only species utilized the area as a nursery ground for the whole year round. Although the adult assemblage remains unclear from this survey, as only 15 of them were caught, catches by traditional fishermen and recreational anglers from this estuary have been found to be mainly of mature adults of all sizes. The estuary, therefore, not only functions as an important nursery ground but may also as spawning or breeding grounds for the ariids. Further research should be taken into account of the role of estuary as spawning or breeding grounds for the ariids.

Water salinity appears to be the most important factor in determining the spatial distribution. Result showed a clear distinction of the catches of each species within each site. The present finding

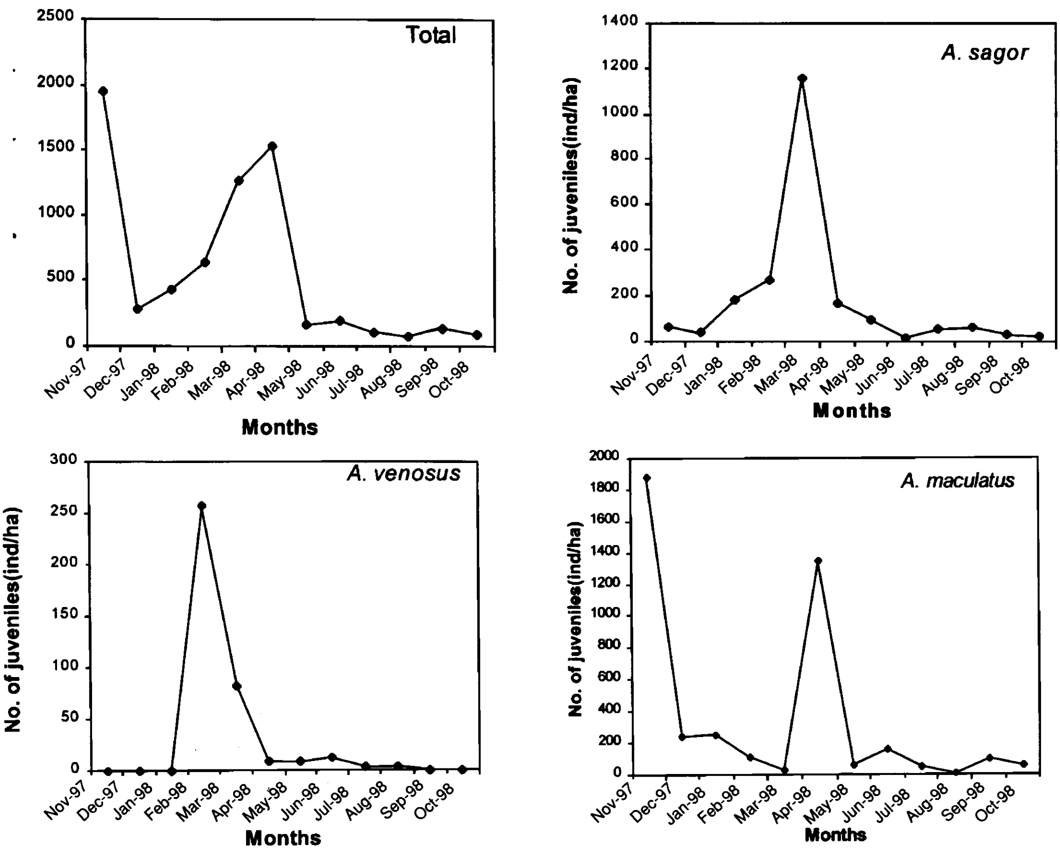

Figure 4. Temporal distribution of ariid juveniles in Saiburi estuary, Gulf of Thailand

Table 1. Spatial distribution of ariid juveniles in Saiburi estuary, Gulf of Thailand

Species	Number of ariid juveniles at each station (ind/ha)			
	A	B	C	Total
A. maculatus	754 (17.5%)	3525 (82.5%)	22 (0.5%)	4301
A. sagor	4 (0.2%)	1834 (85.2%)	314 (14.6%)	2153
A. venosus	0 (0%)	70 (18.4%)	309 (81.6%)	379
Total	758 (11.1%)	5429 (79.5%)	645 (9.4%)	6832

Table 2. Diurnal-nocturnal distribution of ariid juveniles in Saiburi estuary, Gulf of Thailand

Species	Number of ariid juveniles at each period of time (ind/ha)				
	1100-1300hrs	1600-1800hrs	2100-2300hrs	0600-0800hrs	Total (%)
A. maculatus	719 (16.7%)	440 (10.2%)	1874 (43.6%)	1268 (29.5%)	4301
A. sagor	788 (36.6%)	344 (16.0%)	401 (18.6%)	619 (27.8%)	2152
A. venosus	52 (13.8%)	131 (34.5%)	78 (20.7%)	118 (31.0%)	379
Total	1559 (22.8%)	915 (13.4%)	2353 (34.4%)	2005 (29.3%)	6832

supports observation that salinity may limit the upstream movement and distribution of some species in estuaries (Blaber & Blaber, 1980; Loneragan et al., 1987; Blaber et al., 1989). The present study shows that ecological distribution in the estuarine system among species of ariid juveniles may differ. As each species has a preferred salinity range, several conclusions regarding distribution pattern within the estuary can be drawn. *Arius maculatus*, being a euryhaline species, is present throughout the year at station B and sometimes penetrates upstream with lower salinity (Station A). *Arius sagor* is also an euryhaline species preferring a higher salinity gradient (Station B and C). *Arius venosus* is a more restricted marine species sometimes present at Station B. Assemblages of some *A. sagor* at Station A and *A. maculatus* at Station C might be identified as "incidental". These species can be categorized as estuarine-dependent fishes like *Pomadasys kaakan*, *Ambassis* spp, *Herklotsichthys castenui* (Robertson & Duke, 1990) and *Acanthophargus berda* (Blaber et al., 1989). Amongst the three species, *A. maculatus* and *A. sagor* can be considered as permanent residents of Saiburi estuary due to their appearance throughout the year. Moreover, qualitative information gathered from local fishermen and recreational anglers revealed that *A. maculatus* has always been caught between stations A and B, and more often penetrates the inner part of the river. *Arius sagor* has been mainly caught near the river mouth (Station B) and sometimes out to the deeper area of the sea. The study did not indicate the catch of *A. venosus* at Station A and B, but the species is usually caught by gill nets at sea far from the river mouth.

At the temporal level, catch variation was probably represent the real changes in abundance of juveniles rather than the effective of the net or net avoidance behavior. They were present the whole year round in the area, but peak in certain months especially after the Northeast Monsoon season. For *A. maculatus*, peaks occur in two phases, November to January and April indicating that recruitment occurs during these two periods. Additionally, considering the whole estuarine system, changes in water salinity may not be a main factor for recruitment, but significance for species partitioning. As for *A. venosus*, it is noted that juveniles come close to the estuary only once at the end of the Northeast Monsoon and remain in the area for a short time before leaving again to the deeper seas. The species probably utilize the area only during juvenile stage before moving out.

Diurnal-nocturnal activities of fishes could highly influence their distribution pattern (Hobson, 1965). There is a diel pattern of utilization from the study. Juveniles seemed to penetrate and aggregate more at the sampling areas during the night than day and leave for deeper areas by early morning. Aggregation trend was strongest for *A. maculatus* with 43.6% collected during night sampling. On the other hand, collection of *A. sagor* was mostly during 1100-1300hrs (36.6%). In case of *A. venosus*, the highest aggregation was during 1600-1800hrs (34.5%). Night aggregation of *A. maculatus* is similar to species such as *Dicapterus rhombeus, Anchoa cubana* and *A. hepsetus* (Stoner, 1991) and is distributed accordingly to their nocturnal activity. There are several causes of diel movement of fishes into inshore coastal area, including foraging movement, predator avoidance behavior, reproductive behavior and responses to diel changes in physical condition (Rountree & Able, 1993). Nocturnal movement of *A. maculatus* into inshore waters is not likely to result from reproductive movement, since most of the catches were juveniles. Thus only three assumptions can probably be well described nocturnal movement of the species. Combination of foraging behavior, changes in physical conditions and predator avoidance might be the most possibility to affect this movement.

Considering only the two most abundant species, *A. maculatus* and *A. sagor*, they have relatively different patterns of utilization that are diurnally segregated. *Arius maculatus* appeared in the sampling area mostly during the night and early morning, while *A. sagor* was mostly collected during the day. As both species inhabit almost the similar habitat of Station B, the result confirmed that diet competition between the two is minimized. Such resource partitioning leads to naturally efficient utilization of the habitat (Sandheinrich and Hubert, 1984; Schoener, 1974).

Additionally, conclusions reached in this study should be obvious in understanding the role of shallow coastal habitat as nursery ground for ariid juveniles in Saiburi estuary. Significant variations in utilizing each area of each species during each period of time were well clarified even study in other aspects needed to be included.

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