AgEnt 78-94
AgEnt Consultant Report No. 36

Ornamental Marine Fish Collection Impact Survey in Sri Lanka

Alan Friedlander

Research Biologist

The Agro-Enterprise Development Project
Colombo, Sri Lanka

February 1995

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EXECUTIVE SUMMARY

Interviews with government officials, marine ornamental fish collectors, and aquarium fish exporters were conducted to obtain information on number of fishes and species in exports, distributions of important species, and trends in abundances. Export invoices were obtained from several exporters for future analysis of export trends by species over several years. An experimental approach was initiated to evaluate the impact of ornamental fish collection on local populations and to identify natural fluctuations in abundance due to recruitment variability. Several sites were selected around the west coast of Sri Lanka and evaluated based on known levels of collecting pressure. Underwater visual census techniques were utilized to quantify species composition, density, and distribution of selected species important in the ornamental fish trade. A local technician was trained to conduct the monitoring with a sampling protocol established to continue the survey over a 3-year period.

INTRODUCTION

In the past few decades the marine aquarium hobby has experienced a huge increase in popularity, especially in the United States, Europe, and Japan (Randall, 1987). This increase has been due in part to a greater understanding of the captive requirements of these species as well as improvements in closed system technology (Pyle, 1993). Some of the principal sources of marine fish for the aquarium trade include U.S.A., Indonesia, Philippines, Sri Lanka, and Singapore (Andrews, 1990).

The ornamental aquatics sector in Sri Lanka has been previously reviewed by Wood (1985), Mee (1993), and Beets (1994). Export records from the Sri Lankan government report all live ornamental fish together as one unit. External trade statistics for 1993 reported exports of live fish from Sri Lanka at 310,101 kg valued at 52,954,458 RS (Ca. $1,080,00 U.S.) (Sri Lanka Customs, 1993). Currently no records are available which separate marine from fresh water species, species by location, or time period.

In Sri Lanka, many independent collectors provide fish to several large exporters (Wood, 1985). Collectors land their catches in numerous sites around the island at various times of the year, depending on local sea and weather conditions. Exporters do not keep track of or often do not know exactly where specific fish were collected.

Information from collectors can be valuable in obtaining information on number of fishes and species in export as well as general trends in abundance. Studies in Hawaii (Taylor, 1974; van Poollen and Obara, 1984) have relied on data from catch reports submitted by collectors in order to assess the impact of ornamental fish collecting. These

data, while useful at identifying large scale trends in the fishery, do not provide information on the impact of aquarium fish collecting on stocks at the local level.

The densities and distributions of fishes must be assessed in order to derive sound management strategies. Information is needed on natural relative abundances of important marine species captured for the ornamental trade along with the variability of the resources. Fish stocks on coral reefs are replenished by recruitment of larvae from the plankton. In order to assess the impact of collecting, some basic information on the recruitment variability of these species must be obtained. This study has been initiated to provide information on the impact of aquarium fish collecting on natural populations, including assessment of local fish densities and species composition of selected aquarium species along the coast, distribution of important species, evaluation of recruitment variability of selected species, and summary of available market information.

METHODS

Interviews with ornamental fish exporters and collectors-

Interviews were conducted with ornamental fish exporters to obtain information on number of fishes and species in exports, distributions of important species, and trends in abundance. Export invoices were obtained from selected exporters for analysis of export trends by species over several seasons and years. Interviews were conducted with collectors as various locations to determine the preferred collecting habitats and the level of collecting at specific locations.

Experimental approach to evaluate the impact of collecting -

This represents the initial phase of a 3 year study to evaluate the impact of ornamental fish collecting on local stocks. During the course of the study, 3 samples will be conducted per collecting season at each site in order to obtain statistical trends.

Species composition, density and distribution of selected species important in the ornamental fish trade were monitored using underwater visual census techniques. Various sites were selected and evaluated based on the degree of collecting pressure and habitat quality. A local technician has been trained to conduct all aspects of data collection.

Site selection - Sites were selected based on known levels of ornamental fish collecting which are occurring or have occurred in the past. Assessment of fishing pressure was made based on previous experience of one member of the study team (C. Martenstyn), interviews with collectors and exporters, and personal observations at each site. In water reconnaissance and interviews with collects were utilized to determine actual survey areas within a site.

Visual census methodology- Four to six transects (50 x 2 m) were established at each selected site. Compass bearings and measurements to appropriate landmarks were taken in order to easy relocate each transect at a later date. A 50 m fiberglass measuring tape was laid out along the bottom of the reef in a predetermined habitat. The diver swam the length of the transect at a constant speed recording all individuals of select species on

one meter to either side of the transect tape.

Only species from select families of fishes important to the ornamental fish trade were surveyed. These included butterflyfishes (Chaetodontidae), angelfishes (Pomacanthidae), damselfishes (Pomacentridae), surgeonfishes (Acanthuridae), moorish idol (Zanclidae - *Zanclus cornutus*), triggerfishes (Balistidae), filefishes (Monacanthidae), boxfishes (Ostraciidae), and pufferfishes (Tetradontidae and Diodontidae). All species within these families were censused in order to examine trends in target as well as non-target species. Changes in habitat or other anthropogenic effects should affect both collected and non-collected species to some degree. A complete reference collection of fish guides for the area was compiled for accurate identification of species and to provide current valid scientific names (Allen, 1980; Allen, 1991; Allen and Steene, 1987; Allen and Steene, 1994; Burgess et al., 1990; Debelius, 1993; Randall, 1992)

Training - Thorough training was conducted to insure that all data collection was accurate and uniform. Individual fishes were identified to species level when possible. In cases where identification to species level was uncertain, individuals were identified to the lowest taxa possible. Transects were replicated by both observers and data were compared. This process was repeated until both observers felt comfortable with species identification and sampling methodology. Data sheets were transcribed at the completion of each day to reduce possible errors at a later date.

Fish size determination - Determination of fish length is essential in monitoring the variability in recruitment which occurs over time. Project personnel were trained in estimating fish sizes by using small pieces of PVC pipe as models. Pipes of various sizes between 2 - 15 cm were randomly scattered along the sea bottom. The diver first estimated pipe length to the nearest cm and then verified these sizes using a ruler. This was repeated until accuracy was with 1-2 cm of the actual length. Additionally, lengths of live fishes in aquaria and preserved specimens were estimated and then confirmed until observers were completely confident in estimation of fishes of various sizes.

Habitat description - A line intercept method was used to quantify the habitat being sampled. At one meter intervals along the transect tape, the diver recorded the habitat type which appeared at that point under the tape. Habitat was classified as living coral, dead coral with turf algae, sand, crustose coralline algae, macro-algae, sandstone or limestone pavement, soft coral including *Sinularia* sp., or sponge.

PRELIMINARY RESULTS

Description of study sites -

Bar Reef (Kalpitiya) - Bar Reef has officially been declared a marine sanctuary (Gazette, 1992) and is therefore protected from certain practices. Despite difficulties in enforcement, collecting is probably light due to the reef's isolation and distance from shore. This location consists of a series of patch reefs situated 2-4 km from shore. These coral patches have a relatively high percentage of live coral cover consisting mainly of branching coral (*Acropora* sp.) and foliaceous corals (*Echinopora* sp.) (Ohman et al., 1993). The reef slopes gently from 1 m down to 4 m into the sand. Transects were laid

on the mainland side of the reef (east) and parallel to the reef slope.

The Crown-of-Thorns starfish (*Acanthaster planci*) is a predator of living coral and appears to be causing considerable damage to the existing live coral at Bar Reef (densities of 8.5 starfish/500 m^2). The occurrence of Crown-of-Thorns starfish has been observed in increasing numbers at Bar Reef in recent years (Rajasuriya, 1993). A previous outbreak of Crown-of-Thorns was also recorded in Trincomalee Bay in the early 1970's (de Bruin, 1972).

Buena Vista (Galle) - This site is situated in the southeast corner of Galle Bay and is located adjacent to an old concrete dock constructed for a Japanese pearl oyster culture facility. Two different habitats were selected for sampling. The first site was a rocky slope along the shoreline, adjacent to the road (B.V. rock - codes apply to Tables 1 & 2). The habitat consisted mainly of boulders with encrusting coralline algae and small isolated coral heads. Four transects were placed along the slope parallel to the road.

The second site was located in front of a small beach ca. 200 m to the north of the end of the road (B.V. coral). Two shallow coral patch reefs start from shore and go seaward about 100 m. Two transects were conducted on each patch reef.

One small boat (6 m) with 3 fishermen was observed collecting at the deeper edge (5 m) of the coral patch reef area during our visit. A moxie net left by these collectors was recovered after sampling. Conversations with a few local fishermen revealed some ornamental fish collecting was taking place in the area. They also mentioned that some dynamite fishing had occurred recently. Fish collecting at these sites is moderately high and probably only limited by difficulty in getting to the bay. Access to the bay is either down a very steep hill or along a windy dirt road (4-wheel drive preferable).

Hikkaduwa - The reefs around Hikkaduwa have been the most intensively studied in Sri Lanka (Mergerand and Scheer, 1974; Jonklaas, 1981; De Silva and Rajasuriya, 1985; Wood, 1985; Rajasuriya, 1994). The Hikkaduwa Marine Sanctuary was officially established in 1979 (Nakatani et al., 1994). The northern reef area has been severely degraded from sedimentation, coral mining, destructive fishing practices and anchor damage.

Sampling was conducted on the southern reef area adjacent to the Rocky Islets Terrestrial Sanctuary. One survey area consisted of shallow reef flats (1-3.5 m) ca. 300 m seaward of the Coral Gardens Hotel (Hikk. coral). Hard coral cover was relatively high with branching coral dominating (*Acropora* sp.). Soft corals (mainly *Sinularia* sp.) were also found covering the reef.

The second location surveyed was to the southwest (offshore) from Rocky Islets Sanctuary in 6-10 m of water (Hikk. rock). This deeper habitat was dominated by large boulders with some isolated patches of hard coral. Although Hikkaduwa Sanctuary may not afford the area complete protection, there are a large number of local glass bottom boat operators, snorkelers, and other tourist activities which greatly limit the amount of ornamental fish collecting which can occur within the sanctuary.

Weligama - The area adjacent to the Weligama Beach Hotel is a major beach access point for local fishermen. A shallow sandy lagoon (1-4 m deep) extends out from shore ca. 75 m before reaching a very shallow reef flat area. This area almost becomes dry at low tide with only a few surge channels deeper than 1 m suitable for surveying. Coral cover at this site was high with expansive thickets of branching coral (*Acropora* sp.). Some dead coral with turf algae growing over it was observed on the shoreward edge of the reef. In the shallow seaward reef area, a fair amount of newly broken coral was noticed. Several collectors (5-6) were working the area during the survey and some coral damage was invariably a result of these activities.

Conversations with several collectors on the beach revealed that this was a major location for ornamental fish collecting in the area. They stated that roughly 75-100 divers and 5 fish buyers were located there with shipments going to Colombo at least 3-4 times a week.

Colombo - An extensive sandstone reef runs in a north-south direction just offshore from downtown Colombo. The reef consists of sandstone with isolated coral heads and breaks up into large blocks with deep cracks in a number of places. In the Wellawatte area of south Colombo, an area of this reef was surveyed. A deep ledge (5 m deep) about 250 m offshore runs the length of the reef in a north-south orientation. This is an area known for collecting angelfishes and other ornamental fish species. Six transects were conducted along a 300 m length of reef in one of the primary collecting habitats in Colombo. This area probably receives more collecting pressure than any other location within Sri Lanka.

Table 1. Description of locations for visual fish transects. Location codes are given above. Coral cover is the average percent live hard coral based on the number of transects conducted at each location. Standard deviations are given in parentheses. Relief refers to the amount of vertical relief encountered at each site. A slope has high vertical relief while a reef flat has low vertical relief. Complexity refers to the amount of habitat complexity or spatial heterogeneity. Branching coral has high complexity while limestone pavement has low complexity. Collecting is a qualitative assessment of ornamental fish collecting conducted at each location based on interviews and observations.

Location	Coral Cover	Transects	Depth (m)	Relief	Complexity	Collecting
Bar Reef	42.0 (31.0)	6	1 - 3.5	Med.	High	Low
B.V.Rock (Galle)	17.5 (10.0)	4	1 - 3.5	High	Med.	Med.
B.V. Coral (Galle)	56.5 (12.4)	4	1 - 5	Med.	Med.	Med.
Hikkaduwa Coral	37.0 (16.0)	4	1 - 3.5	Low	Med.	Low
Hikkaduwa Rock	19.0 (9.2)	4	6 - 10	High	Low	Low
Weligama	48.5 (18.4)	4	1 - 2	Low	High	High
Colombo	0.1 (0.2)	6	4-5	Med.	Med.	High

Species composition and distribution -

Using visual census techniques, species composition, density and distribution of selected species were recorded from various habitats and different geographic locations along the west coast of Sri Lanka. Damselfishes (Pomacentridae) were the most specious family observed with 22 species occurring within the transects. Other families of fishes which had high numbers of species included the Butterflyfishes (Chaetodontidae, 16 species) and surgeonfishes (Acanthuridae, 11 species).

The highest number of species observed was 30 at the Buena Vista rocky shoreline habitat followed by Bar Reef with 25 species. The lowest number of species were recorded at Weligama (13 species) and Colombo (15 species).

Table 2. List of species seen during visual transects. Location codes and habitat descriptions are found above and in Table 1.

SCIENTIFIC NAME	BAR Reef	B.V. rock	B.V. coral	Hikk. coral	Hikk. rock	Weli.	Colo.
Chaetodontidae - butterflyfishes							
Chaetodon auriga				X			
Chaetodon citrinellus				X	X		
Chaetodon collare	X				X		X
Chaetodon decussatus		X	X		X	X	X
Chaetodon kleinii					X		
Chaetodon lineolatus	X						
Chaetodon lunula							
Chaetodon melannotus	X						
Chaetodon meyeri		X		X			
Chaetodon octofasciatus	X						
Chaetodon plebius	X	X					
Chaetodon trifascialis	X	X	X	X			
Chaetodon trifasciatus	X	X	X	X		X	
Chaetodon vagabundus				X			
Heniochus acuminatus							X
Heniochus pleurotaenia	X						
Pomacanthidae - angelfishes							
Centropyge multispinus		X	X				
Pomacanthus annularis					X		X
Pomacanthus semicirculatus	X						
Pomacentridae - damselfishes							
Abudefduf vaigiensis		X	X	X		X	
Amblyglyphidodon leucogaster	X						
Chromis dimidiata		X		X	X		
Chromis ternatensis		X	X				X
Chromis viridis	X	X	X			X	
Chrysiptera leucopoma		X	X	X			
Chrysiptera unimaculatus	X	X	X	X			
Dascyllus aruanus	X	X					
Dascyllus carneus		X					
Dascyllus trimaculatus		X					
Neopomacentrus azysron	X	X	X	X	X		X
Neopomacentrus cyanomos							X
Plectroglyphidodon dickii	X	X	X	X	X	X	
Plectroglyphidodon lachrymatus	X	X	X	X	X	X	

SCIENTIFIC NAME	BAR Reef	B.V. rock	B.V. coral	Hikk. coral	Hikk. rock	Weli.	Colo.
Pomacentrus chrysurus	X	X	X	X	X	X	X
Pomacentrus indicus						X	
Pomocentrus philippinus		X	X	X	X	X	X
Pomocentrus proteus							X
Pomacentrus similis		X	X		X	X	X
Pomacentrus species				X			
Stegastes fasciolatus		X		X			X
Stegastes nigricans	X	X				X	
Acanthuridae - surgeonfishes							
Acanthurus leucosternon	X	X	X				
Acanthurus lineatus	X	X	X	X			
Acanthurus nigrofuscus			X	X		X	X
Acanthurus species		X		X			
Ctenochaetus binotatus		X	X				
Ctenochaetus species	X						
Ctenochaetus striatus	X		X			X	
Ctenochaetus strigosus		X			X		
Naso species	X						
Zebrasoma scopas	X			X			
Zebrasoma desjardinii	X						
Balistidae - triggerfishes							
Balistapus undulatus			X		X		
Sufflamen bursa					X		
Sufflamen chrysopterus					X		X
Monacanthidae - filefishes							
Alutera scripta		X					
Tertaodontidae - boxfishes							
Arothron nigropunctatus					X		
Canthigaster solandri							X
Canthigaster valentini		X					

DISCUSSION

To date, no study has provided information on the impact of aquarium fish collection on natural marine populations in Sri Lanka. This report represents a description of the methodology used to implement the statement of work for the ornamental marine fish collection impact survey in Sri Lanka which was proposed by Dr. Jim Beets in collaboration with the Wildlife Heritage Trust. These preliminary data should not be interpreted at quantitative comparisons among sites based on the present levels of aquarium fish harvest since other anthropogenic effects as well as habitat variability can greatly effect the distribution of fishes.

This study is meant to provide information on the effects of ornamental fish collecting on natural populations at specific sites over a 3 year time period. The data provided at the conclusion of this study will help to determine the distribution of important species within the fishery, identify trends in recruitment, and assess local fish densities and species composition of aquarium trade species.

One of the greatest problems associated with impact assessment is the difficulty in controlling for natural population fluctuations. Relative population abundance may fluctuate over time, either seasonally, or from year to year. By sampling throughout the collecting period and over a 3 year period we hope to account for some of this natural variability. Two additional sampling trips will be conducted this year during the primary collection period on the west coast (December to April). This schedule will be repeated over the next two years. All data will be statistically analyzed and presented in a scientifically-sound report. This approach should provide data necessary for the evaluation of the impact of ornamental trade collection for important species as well as natural variability in the system.

ACKNOWLEDGEMENTS

This study was conducted with the assistance of numerous people in Sri Lanka. Cedric Martenstyn was critical in all aspects of this preliminary work. His knowledge of the resources, professional contacts, and proficiency in the field greatly improved the quality of the study. Many people in the ornamental fish industry, government agencies, and conservation groups provided valuable perspectives towards implementing this work. These people included: David Claasz, Ananda Pathirana, Rohan Pethiyagoda, Dr. Elmo Weerakoon, Arjan Rajasuriya, and Dr. Alan White. This project could not have been done without the support of Richard Hurelbrink and the entire staff of the AgEnt Project. US AID staff also provided useful comments and suggestions for project design.

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