



operations using portable pots on the shoals to the north and northwest of Tutong and to the northwest of Muara Port.

The number of full-time fishermen in 1979 was about 400; 20% were temporary immigrant workers from neighboring countries. Additionally, there were nearly 700 part-time fishermen.

Because of the many part-time fishermen, it has proven impossible to assess the total fishing effort, a problem compounded by the wide scattering of the fishing villages and landing places. The number of power boats used for fishing in 1979 included nearly 600 outboard and 6 inboard motor boats. Total fisheries production in 1979 based on quantities appearing in the municipal markets in

Beam trawl cod end is hoisted aboard during penaeid prawn study (top left) and Brunei's Deputy Director of Fisheries Matdanan bin Haji Jaafar inspects a rope of green mussels (right). Photos by R.W. Beales.

Brunei Fisheries and Research

RICHARD W. BEALES

Former Director of Fisheries, Brunei

Present address: 6 Doriston Count, 84 Surrey Road
Branksome, Poole, Dorset BH12 1EQ, U.K.

Capture Fisheries

Existing fisheries are almost entirely artisanal, using traditional gear such as portable pots (bubu), handlines (kail/pan-ching), longlines (rawai) and drifting gill nets (rantau) in offshore waters, mainly for the capture of carangids, lutjanids, serranids and scombrids; and bottom-set gill nets (andang), trammel nets (andang karan) for penaeid prawns, and various fixed palisade traps (kilong/lintau) for a variety of inshore species of lesser importance.

The fishery for penaeid prawns is concentrated in the extensive estuarial system in the northeast, and being close to the State's capital, Bandar Seri Begawan, is of considerable nutritional, economic and social importance. The three major species in the catch are *Penaeus merguensis*, *Metapenaeus brevicornis* and *Penaeus indicus* (udang), with a further eight species reported in the area.

Fishermen from the small fishing communities on the South China Sea coast operate mainly close to the shore in small, open boats, while the remaining communities specialize in wider-ranging

Bandar Seri Begawan, Tutong, Seria and Kuala Belait was 2,809 t, with a further 1,824 t imported to satisfy demand.

There is no fishery of any substance in the deeper offshore waters of the State.

Stock Assessment

Stock assessment has been carried out exclusively by the operation of the Fisheries Department's research and training vessel *K/P Lumba-Lumba (R/V Dolphin)* a specially modified 15.2-m l.o.a., steel-stern trawler from the UK fleet. The aim is to provide resource data to enable proper consideration of investment and development requirements for the establishment of a small, offshore, commercial trawl fishery using modern vessels, gear and techniques appropriate to resource availability and to the skills and aspirations of the local fishermen.

A demersal trawl survey to 170 m deep was carried out in 1979-1980. One survey area of approximately 2,735 square nautical miles was subdivided into two strata for purposes of sampling, the major effort being applied to the more productive inshore stratum. A total of 205 valid trawl hauls were made using a Boris Goshawk 17.5-m headline box

Brunei, in the northwest coast of the island of Borneo, has a sea coastline approximately 70 nautical miles in length bordering the South China Sea, with a complex, mangrove-fringed estuarine system at the northeastern end of the State. The 100-fathom (200-m) isobath varies from about 35 nautical miles at the eastern end. The bottom sediments offshore are predominantly mud and sandy mud, with some sand and coral patches nearer shore.

The mainstay of Brunei's economy is an extensive oil and natural gas industry whose operations are conducted largely offshore. Thus, the numerous structures, pipelines and service vessels associated with this industry have a considerable bearing on offshore fisheries development and management.

All matters relating to fisheries in the State are the responsibility of an independent Fisheries Department, whose field activities are conducted from a new and well-equipped field station at Muara Port.

trawl. Mean catch rates (in kg per hour of trawling were:

Catch	Stratum	Stratum
	1	2
Total catch	324	46
Trash catch	59	17
Marketable catch	265	29
(a) Leiognathids	159	4
(b) Others	106	25

The striking feature was the large proportion of leiognathids (ikan bilis), which, although marketable in Brunei, would soon saturate the fresh-fish market. The Fisheries Department's Post-Harvest Section is developing methods for converting the surplus into fish balls and fish fingers/cakes for human consumption, and into fish silage as an animal feed additive. Considerable success has been achieved in the latter at a laboratory scale, and feeding trials carried out by a commercial feed mill are encouraging.

Preliminary estimates for the areas accessible to trawling suggest a potential yield of marketable species (including potentially usable species such as leiognathids) of 7,500 t in Stratum 1 and 2,500 in Stratum 2.

Data from 13 hauls were used to monitor escape of fish from the cod-end of the trawl net. Results showed that with 35-mm mesh in the cod-end with a 16-mm stretched-mesh cover, the average catch rate was 253 kg/hr, of which only around 8% escaped through the 35-mm cod-end into the cover.

Aquaculture

Aquaculture projects were carried out to assess their potential. Oyster culture trials, for one, were made in 1977-78,

but the native species, a mangrove oyster (*Saccostrea cucullata*) showed disappointing growth performance. There was some spatfall every month but the oysters virtually stopped growing after reaching 2.5-3.0 cm length. In contrast, Brunei's neighbor (Sabah) successfully used its mangrove oyster (*Crassostrea belcheri*) in culture trials which produced market-sized oysters in 18 months. This species has been proposed for introduction into Brunei's waters.

Culture of another exotic species, the green mussel (*Perna viridis*) has met with more success. Trials through 1980, using spat from Singapore, showed that mussels reached the market size of 6.5-7.0 cm in 4-5 months from 2.0-cm spat. Gonadal development was good, but in view of the small quantity of stock, there was no spatfall.

Problems

Supply of spat represents one constraint to development of the mussel industry.

Large areas off the coast are inaccessible to trawling due to pipelines and other structures associated with the oil and natural gas industry.

A greater problem is that of paralytic shellfish poisoning, a phenomenon which first appeared in Borneo in 1976. Blooms of a toxic plankton organism, *Pyrodinium bahamense*, covered almost the



The Brunei Fisheries Department's research vessel *K/P Lumba-Lumba* trawling and streaks of "red tide" off the Brunei coast (March 1976). Photos by R.W. Beales.

whole western coast of Borneo from March to May, resulting in at least 7 human deaths and 105 hospitalizations in Sabah from eating shellfish exposed to the blooms (called "red tide"). There were 14 non-fatal cases of paralytic shellfish poisoning in the 1976 Brunei outbreak, in persons consuming the plankton-eating fish *Rastrelliger*.

Brunei and Sabah suffered these "red tides" again from May to November in 1980, and weekly plankton monitoring in Brunei has shown the organism to be firmly established. The Brunei Fisheries Department is using *Perna viridis* as an indicator organism for regular bioassay. The mussels were still toxic in July 1981. In Sabah, two deaths amongst a group of Vietnamese refugees occurred after eating affected shellfish in May 1980.

Red tides are a constraint not only in the development of the bivalve shellfish industry in western Borneo, but also in the utilization of some fish resources there, at least during bloom periods.○

Sources

- Beales, R.W. 1976. A red tide in Brunei's coastal waters. *Brunei Mus. J.* 3(4): 167-182.
- Beales, R.W. The demersal resources of Brunei accessible to trawling. (In preparation)
- Currie, D.J. 1979. Settlement and growth of the oyster *Saccostrea cucullata* in Brunei waters. *Brunei Mus. J.* 4(3):182-198.
- Currie, D.J. 1980. A beam trawl operated from an outboard dory. *Brunei Fish. Dep. Tech. Rep. TR/01.* 12 p.
- Currie, D.J. 1980. Brunei Bay prawn reefs. *Brunei Fish. Dep. Tech. Rep. TR/02.* 22 p.
- Currie, D.J. 1981. Studies on the biology of penaeid prawns and the prawn fishery in the Brunei estuary. *Brunei Fish. Dep. Tech. Rep. TR/05.* 68 p.
- Lindley, R.H. 1980. Cod-end escapement from a demersal trawl with particular reference to the *Leiognathidae*. *Brunei Fish. Dep. Tech. Rep. TR/03.* 18 p.
- Lindley, R.H. 1981. Studies on the growth and aquaculture potential of the green mussel *Perna viridis* in Brunei waters. *Brunei Fish. Dep. Tech. Rep. TR/04 (Rev. 1).* 11 p.
- Roy, R.N. 1977. Red tide and outbreak of paralytic shellfish poisoning in Sabah. *Med. J. Malays.* 31(3): 247-251.
- SEAFDEC. 1980. Report of technical workshop on fisheries statistics and stock assessment, 8-12 September 1980. Bangkok, Thailand. Southeast Asian Fisheries Development Center, Bangkok. 120 p.
- The Technical Reports above are available from the Director of Fisheries, P.O. Box 2161, Bandar Seri Begawan, State of Brunei.

