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Coconut Crab Ecology in Vanuatu

by

Dr W.J. Fletcher
ACIAR Fisheries Research Branch

INTRODUCTION

1. The A.C.I.A.R. (Australian Centre for International Agricultural Research) funded project on coconut crabs (Birgus latrou) in Vanuatu was devised to investigate the biology and ecology of this, the largest land crab. Due to their land-dwelling habits, their ease of capture and their large size, they have been a highly prized traditional food item throughout much of the tropical Indo-Pacific. Their unique flavour and appearance has also made them popular with tourists at restaurants. Unfortunately, such popularity has resulted in the collection of a vast number of coconut crabs and has, therefore, placed the future of this species in jeopardy.

2. The ACIAR project on coconut crabs was instigated in 1983 at the request of the Vanuatu Government, who recognised the need to study this species, because little was known about their biology, to enable a rational plan of management to be formulated. Such a plan is vital for the conservation of this harvesting industry which is of considerable socio-economic importance, especially to communities in the more remote areas. To this end, three main areas of research were undertaken;

(a) to examine the influence of exploitation on population structure and stock density;

(b) to determine the crabs natural growth rate, and

(c) determine the processes influencing recruitment of juveniles.

POPULATION STUDIES

3. Coconut crabs are generally nocturnal and are found in the coastal forest regions of many islands throughout Vanuatu and the remainder of the Pacific. During the day they "hide" in caves and ledges, which are abundant in the eroded limestone cliff areas of most coastal regions. Elsewhere, they hide underneath trees, in hollowed tree-stumps and occasionally in burrows. They are generally found within a few hundred metres of the ocean although a few have been seen as far as 5 km from the sea.

4. To catch the crabs for our study, we used the same method as that utilised by the local collectors; a trail was cut through the jungle with a number of coconut baits placed in areas near where crabs may be hiding. The baits were revisited after dark and any crabs that were attracted to the baits were caught, measured, tagged and released. The crabs were probably attracted to the strong aroma of the coconuts. Interestingly, coconuts do not normally form a major part of the diet of Birgus because;

(a) in many places where Birgus was found there were no coconut palms;

(b) it takes about three weeks for large crabs to open a nut; and

(c) small crabs were unable to open the nuts at all. In reality, coconut crabs are omnivorous, eating both plant and animal matter, and appear to be largely opportunistic scavengers.

5. The numbers of crabs we caught per coconut bait, and the average size of the crabs caught, varied greatly among different locations. We found that these differences were related to the history of previous exploitation at these places. Thus, areas where harvesting had been occurring over many years had very few crabs (about 2 or less per 10 baits) and most of these were under the legal size (9 cm cephalothoracic length). At sites where collections had been minimal, the numbers of crabs caught was large (up to 5 crabs per bait) and virtually all the crabs were well over the legal size. Of greater importance was the observation that this rate of capture could decline very rapidly. At one site in the Torres Is., the catch rate had dropped from about 5 crabs/bait in Dec 1985 to less than 1 crab/bait in Oct. 1987. Consequently, it is obvious that this species can be over exploited very quickly.

GROWTH

6. There are two main reasons for this rapid decline in stocks. Firstly, the growth of coconut crabs is very slow. We estimated the growth rate of individuals using 3 independent and innovative techniques. This was necessary because coconut crabs, like all crustaceans, can only grow by shedding their old "shell" and producing a new, larger one. Most normal methods of marking individuals to follow their increase in size are, therefore, inappropriate because any external mark is lost with the old shell.

7. One of our methods of estimating growth utilised the marking of the crabs using cryogenics (freeze-branding). This method affects the tissue underneath the old shell causing a mark to be produced on the new shell, thereby enabling the individual to be recognised. A general programme of branding in 1986 on the large island of Santo was unsuccessful (only 2 post-moult recaptures) due to variable branding success and very low rates of recapture experienced. In 1987 we restricted the use of an improved branding method to 2 small island sites (1 -3 ha). This has resulted in vastly increased success with over 20 post-moult recaptures found.

8. Coconut crabs moult in subterranean burrows which the local collectors are adept at finding. Occasionally, crabs were found which had already moulted but had not yet consumed their old exuviae, enabling the increment of growth to be measured directly. Over 20 such animals were found, although they all tended to be larger individuals because burrows of small crabs are difficult to locate.

9. Lastly, a population of crabs was maintained in individual enclosures to investigate their growth increment and frequency of moulting. This was largely unsuccessful because only very small crabs (<3cm long) appeared to grow normally under these conditions. Larger crabs generally did not increase in size at all when they moulted and many actually became smaller. This is consistent with the results of Amesbury (1980) for captive animals and indicates that "farming" of crabs, in enclosures is not viable.

10. Most aquatic crabs are able to increase their size significantly by the rapid uptake of water as they shed their old shell. For coconut crabs, however, because they moult underground this means they have no free water with which to swell their new body. They are unable, therefore, to increase in size by a large amount. The moult increment was, therefore, generally less than 10% per moult and at larger sizes there was only about a 2% increase.

11. The timing and frequency of moulting was studied by observations on the captive animals, mark-recapture data of crabs from the small islands and by the change in the average exoskeleton condition (newly moulted - old) of individuals caught in the population surveys. Small crabs (<3 cm) moult up to 3 times per year. This rate decreases until the crabs become about 6cm long after which they moult only once per year, generally in the winter months. It is likely that very large crabs moult even less frequently than this.

12. Using the changes in moult frequency and the changes in moult increment with size has allowed the relationship between size and age to be estimated. It probably takes about 12 - 15 years to reach legal size (approx. 600 g in weight) and more than 30 yrs to become a large (>2 kg) crab. It is likely that Birgus has a lifespan exceeding 50 years.

SPAWNING & RECRUITMENT

13. The second major problem for the continuation of this fishery (in Vanuatu at least) is that few juveniles appear to enter the populations to replace those adults which have been harvested. This is despite the fact that egg-bearing females are regularly found between December and March and each of these carry tens of thousands of eggs. So, what happens to all these potential crabs?

14. The females carry the developing eggs under their bodies attached to the hairs on the abdominal appendages for approximately one month. When the eggs are mature, indicated by their dark grey color (immature eggs are bright orange), the females "release" the eggs into the ocean where they hatch immediately into zoeal larvae. These larvae remain in the ocean for 20 - 30 days where they undergo four moults (as well as being subject to predation and starvation) whereupon they moult into a glaucothoe which are capable of leaving the water and taking up a terrestrial existence. This is the only stage where the coconut crab houses it's abdomen in a gastropod shell, belying their hermit crab ancestry. In two years of searching we failed to find even one of these newly recruiting coconut crabs. In contrast, we found numerous recruits of the many closely related hermit crab species (Coenobita spp.). Furthermore, only 4 coconut crabs < 2cm long were found in the entire study, and most indigenous people had never seen any at all. One possible reason for this dearth in recruitment could be that Birgus larvae are benthic in nature, i.e. they tend to sink to the bottom. Given the rapid drop-offs encountered close to shore in Vanuatu, it is possible that most larvae merely sink to a depth beyond their capacity to return to a sandy beach (from which they gain access to a terrestrial existence). Thus, recruitment may only occur if the larvae become entrapped in a shallow embayment.

15. One of the most disturbing aspects of our studies was that after the crabs have been cleared out of an area there seems to be no evidence of a return by the crabs, even years later. This again points to a fickle pattern of recruitment, it also may indicate adverse interactions with other coenobitids which seem to increase in number greatly in areas where large coconut crabs have been removed.

RECOMMENDATIONS

16. One of our major tasks was to provide the Fisheries Dept. of Vanuatu with a series of recommendations to help ensure the survival of their resource of coconut crabs. It is clear from the results to date, however, that Birgus is not a "good" species to harvest commercially. Consequently, controls need to be strong and, more importantly, strictly enforced. In fact to be absolutely sure of saving the crabs it may be necessary to ban all collections for sale to restaurants etc. In the absence of such a draconian step, which is unlikely to be possible, we have formulated a number of measures which should reduce the likelihood of local extinctions occurring.

A. First and easiest is a publicity campaign to draw attention to the crabs' precarious situation.

B. Strong legislation needs to be invoked. The numbers of crabs being removed from areas needs to be monitored and preferably have some quota system applied. To accomplish this all sales probably need to be restricted to a few vendors (preferably a govt. fish market). This prohibits "back door" sales to restaurants which are almost impossible to monitor quantitatively.

C. Regular (yearly) censuses of the remaining stocks of crabs need to be done to monitor the effectiveness of the program and potentially to set the following years quotas. A safe limit would be that areas should not be harvested after the CPUE falls much below 1 crab/bait.

D. The provision of total sanctuary areas provides a safety factor in case other controls are ineffectual, or unworkable.

E. Possibly, in the long term, the only method of maintaining a fishery would be the regular re-seeding of areas with artificially reared juveniles. We were able, with very primitive apparatus to rear 100 glaucothoe, and it is possible that this production could be increased if more funds for a better rearing facility were available.

17. Whilst these recommendations were developed basically for Vanuatu, they are probably applicable to most countries with any stocks of coconut crabs remaining. In Vanuatu, if these measures are not adopted then there is little hope of the crabs surviving, not only as a cash crop, but as an extant species.