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Feeding ecology of the coral trout, *Plectropomus leopardus* (Serranidae), on the Great Barrier Reef, Australia.

by
Jill St John
(BSc. Hons, Sydney)

A thesis submitted for the degree of Doctor of Philosophy
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Third fisherman :

Master I marvel how the fishes
live in the sea

First fisherman :

Why as men do a-land
the great ones eat up the little ones

Shakespeare Pericles Act ii sc 1 l. 29 1608

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ABSTRACT

The Great Barrier Reef (GBR) is the largest coral reef system in the world and the coral trout, *Plectropomus leopardus* (Pisces: Serranidae, Lacepede 1802) is one of its most widespread and abundant piscivores (Ayling and Ayling 1986). Despite the importance of the coral trout fishery, very little is known about the feeding ecology of *P. leopardus* on the GBR.

The principal objective of this study was to describe the diet and feeding of *P. leopardus* on this large reef system. Variation in the diet of this piscivore over a range of latitudes along the GBR and on reefs open and closed to fishing was examined. Seasonality of feeding by *P. leopardus* was addressed by comparing rates of digestion, consumption of food and diet in the austral summer and winter. Within populations of *P. leopardus,* the ontogenetic shifts in diet and individual feeding behaviour were examined.

Plectropomus leopardus is one of the major predators of adult coral reef fishes on the GBR. After their first year of life, *P. leopardus* are almost entirely piscivorous on adult fishes (99% of fish diet). The dominance of fish in the diet does not vary temporally or spatially.

Feeding studies have shown that *P. leopardus* are intermittent feeders, consuming an average of one prey item daily. After 24 hours, approximately 90% of prey items were digested. Thus, contents of stomachs represented daily feeding in *P. leopardus.* Seasonal rates of food consumption were not related to rates of digestion in *P. leopardus.*

In *P. leopardus*, the major dietary shift in the type, species composition, length and shape of prey occurred at approximately 20 cm SL and corresponded to the onset of sexual maturity. Juvenile *P. leopardus* consumed a higher proportion of benthic crustaceans, mostly penaeid prawns. Though families of prey fish in the diet varied ontogenetically, the breadth of the diet (in terms

of family richness) did not increase with the size of predator . This shift in diet must be due to a change in feeding behaviour because juvenile *P. leopardus* live in similar habitats to adults.

Overall, Pomacentridae were the dominant family in the diet of *P. leopardus.* The main families in the diet of *P. leopardus* were divided into two groups. Common families (Pomacentridae, Labridae, Caesionidae and Scaridae) constituted a consistent and substantial portion of the diet. Small schooling fishes (e.g. Clupeidae), were a highly variable component of the diet both temporally and spatially. Sporadic appearances of small schooling prey in the diet of *P. leopardus* were the main cause of the reduction in dietary overlap between reefs and times.

The abundance of prey in three common families varied latitudinally in the diet of *P. leopardus* . Pomacentridae and Caesionidae were consumed more in the northern GBR whereas Scaridae were eaten more in the south. There were no detectable effects of fishing on the diet of *P. leopardus.* Dietary overlap among reefs zoned for different levels of fishing were within natural spatial and temporal variations for the GBR. Most of the major changes in the diet of *P. leopardus* occurred before the piscivores entered the fishery (current legal minimum size is 38 cm FL). Adult *P. leopardus* prey on juvenile *Plectropomus* spp. and thus high densities of adults may reduce abundances of juveniles.

The major seasonal difference in feeding was a higher consumption of food in winter that coincided with increased production of mesenteric fat that is stored in preparation for reproduction (Ferreira 1993). Family richness in the diet increased during winter months because rare prey were consumed to meet a higher requirement for food. Otherwise, composition of the diet did not vary seasonally. *Plectropomus leopardus* did not appear to respond to the seasonal influx of recruits to the reef during summer; newly recruited prey individuals were consumed rarely.

Plectropomus leopardus appear to be selective feeders in terms of both families and species of prey. At a family level, 37 families were identified in the stomachs of *P. leopardus*. Many abundant families of fishes on the GBR (e.g. Chaetodontidae, Holocentridae, Pomacanthidae and Siganidae) were rarely eaten while others (e.g. Haemulidae) were not identified in the diet at all. The choice of species among the Pomacentridae was examined. Approximately 25% of the 120 possible species of Pomacentridae were identified in the stomachs of *P. leopardus*. Some of these prey species were eaten in much higher proportions than expected when compared to their general abundance on reefs (e.g. *Acanthochromis polyacanthus*) whereas other species were eaten in much lower proportions (e.g *Pomacentrus amboinensis, Pomacentrus moluccensis* and *Neopomacentrus azysron*).

The abundance of families (measured by digested weight) in the diet of *P. leopardus* was compared to the biomass of prey fishes on another midshelf reef on the Central GBR (Williams and Hatcher 1983). The top five ranked families in the diet of *P. leopardus* (Pomacentridae, Caesionidae, Scaridae, Labridae and Serranidae) were also the top five families in terms of biomass on reefs. Furthermore, these five families represented approximately 80% of both fishes on reefs and the total biomass of the prey in the diet. Prey in families were not eaten in exactly the same ranking as biomass on reefs. There was a large difference between the proportions of the two major prey species, Pomacentridae and Caesionidae, on midshelf reefs. *Plectropomus leopardus* consumed more Pomacentridae than Caesionidae even though the biomass of Caesionidae on the reef was more than double that of Pomacentridae. The modes of life of schooling, mobile Caesionidae and demersal, site attached Pomacentridae differ on coral reefs and this may explain the reversal of ranks of these two families in the diet of *P. leopardus*.

In general, the size of prey and composition of the diet *P. leopardus* was related to the size of the predator. As the gape of *P. leopardus* limits the size of prey ingested, the critical dimension of the prey is depth rather than length.

When feeding on larger prey items, small to medium-sized *P. leopardus* (< 35 cm SL) appear to feed optimally as defined by Werner (1974) with respect to body-depth of prey. This size-related feeding did not occur under all circumstances. Size of prey was decoupled from size of predators for all *P. leopardus* larger than 35 cm (SL) and when the prey were small schooling fishes. It appears that *P. leopardus* switch to feeding on small schooling fishes when they are available.

Predatory behaviour of *P. leopardus* in tanks was highly variable among individuals. Both the success of capture of *Acanthochromis polyacanthus* (F. Pomacentridae) and the consistency of predatory abilities varied among individuals. Individual variation in feeding may help explain the high variability in growth and fecundity of individuals observed within populations of *P. leopardus* (Ferreira 1993; Davies 1995).

The abundance and species richness of the families common in the diet of *P. leopardus* suggests that food for the coral trout fishery is sufficient on the GBR. Furthermore, feeding by *P. leopardus* appears to be unaffected by this human activity at present levels of fishing. Other aspects of this study, however, suggest that fishery managers cannot be complacent. The effects of cannibalism within the fishery need to be understood. Fishing may reduce predation on prey on reefs directly by removing predators and, in the case of line fishing, indirectly by feeding predators. Data from the fishery should be treated with caution for two reasons. Firstly, Catch Per Unit Effort (fish per fisher per hour) was considered a poor method to estimate or compare the population density of *P. leopardus* as more of the catch was taken by line when a high proportion of the population was hungry. Secondly, line fished samples of *P. leopardus* should not be used for dietary studies as the abundance and composition of prey was biased by regurgitation and the presence of bait. Line caught fish had fewer natural prey in their stomachs and the composition of the natural diet differed from the sample caught by spear.

In conclusion, the major sources of variability in the diet and feeding behaviour of *P. leopardus* were the following:

1. ontogenetic shift from juveniles to adults,
2. high individual variation in successful capture of prey, and
3. regional variation in the diet.

In contrast, seasonality and varying levels of fishing had little effect on the diet of *P. leopardus*.

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