3 EARLY LIFE HISTORIES

3.1 *Lethrinus* spp.

Very little is known of the early life histories of *Lethrinus* species. *Lethrinus* larvae do, however, make significant contributions to light trap collections (P. Doherty, M. Milicich, S. Thorrold pers. comm.) and ongoing studies in this area may significantly advance our knowledge.

3.1.1 Descriptions and Identification of Larvae and Eggs

Pelagic eggs of *Lethrinus* and the closely related genus *Gymnocranius* are spherical and small (0.68 - 0.83 mm in diameter) (Mito 1963, Renzhai and Suifen 1980, both cited in Leis and Rennis 1983).

Larvae of lethrinids are distinguished by their distinctive head spination, in particular by an early forming supra-occipital crest with a long, serrate spine. See Leis and Rennis (1983) for a detailed description.

Figures of *Lethrinus* larvae (probably more than one species) at different stages of development are given in Leis and Rennis (1983).

3.1.2 Ecological Information

The very little data that are available on horizontal and vertical distributions of lethrinid larvae suggests that they are very similar in behaviour to lutjanid larvae.

3.1.2.1 Horizontal Distributions

In shallow waters around Lizard Island, Leis (1986) found pre-flexion larvae more abundant on the downstream side of the island than on the windward side of the lagoon. Williams et al. (1988) found lethrinid larvae more abundant at mid- and outer shelf waters between reefs off Townsville than in nearshore waters or the Coral Sea. Cross-shelf light-trapping off Townsville has shown maximum abundance of lethrinids in the outer half of the GBR lagoon and mid-shelf reefs (Doherty unpubl. data).

3.1.2.2 Vertical Distributions

In very shallow waters (to prefer the deepest depth sampled (6m cf. surface and 3m) during the day, but were more evenly distributed at night (Leis 1986). In contrast, Doherty (unpubl. data) has found that pelagic (= pre-settlement) juveniles of this family are aggregated in the upper 5m of the water column, at least at night.

3.1.2.3 Seasonality

Lethrinids have been prominent in light-trap catches from Lizard Island (Milicich and Meekan unpubl. data) and the cross-shelf transect off Townsville (Doherty unpubl. data), especially during spring months (September, October). It is possible that some species reach peak abundance earlier, before the start of sampling.

3.1.2.4 Growth and Length of Larval Period

Brothers et al. (1983) give an age of 37 days at settlement for a single individual of *L. nebulosus* (SL=19.1mm) based on assumed daily growth increments in the otolith of a newly-settled fish.

3.2 *Lutjanus* spp.

The following is almost entirely excerpted from Leis's (1987) review.

3.2.1 Descriptions and Identification of Larvae and Eggs

Lutjanids spawn spherical, pelagic eggs ranging in diameter from 0.65 to 1.02mm, with the majority single colourless to slightly yellowish oil droplet of 0.12 to 0.20mm diameter is present. Incubation times range from 17 to 36 hours depending on species and incubation temperature.

The most striking features of larval lutjanids are the spination of their fins and head (see Figs in Leis and Rennis 1983). Lutjanid larvae are relatively easy to identify to family (Leis and Rennis 1983) but it is much more difficult to distinguish species. General descriptions of eggs and larvae are given in Leis (1987). Leis (1987) gives a useful table (Table 4.3) of characters used in separating larvae of four lutjanid subfamilies.

Partial descriptions of the eggs or larvae of the following GBR species of *Lutjanus* are available:

Eggs (summarised in Leis 1987)	*L. erythropterus* (Lu Suifen 1981)
	L. kasmira (Suzuki and Hioki 1979)
	L. Lutjanus (Lu Suifen 1981)
	L. vittus (=L.vitta) (Lu Suifen 1981)
Larvae	*L. (*bohar?) (Fourmanoir 1976)
	*L. (*fulvus or kasmira) (Leis and Rennis 1983)
	L. johnii (Lim et al. 1985)
	L. kasmira (Suzuki and Hioki 1979)
	L. sebae (Leis 1987)
	L. vittus (Lu Suifen 1981, Mori 1984)

3.2.2 Ecological Information

Relatively little information is available on any aspect of lutjanid early life history. The most intensively studied Indo-Pacific species appears to be *L. vitta* (Mori 1984).

3.2.2.1 Horizontal Distributions

GBR lagoon waters, rather than reef waters, appear to be the nursery area of lutjanid larvae (Leis and Goldman 1983, 1987). Larvae of *Lutjanus* spp are also more abundant in the GBR lagoon (i.e. on the continental shelf) than in the Coral Sea (Leis and Goldman 1984). Leis and Goldman found no cross-shelf variation in the distribution of lutjanid larvae across short transects in the lagoon near Lizard Is. but Williams et al. (1988) found lutjanid larvae concentrated in mid- and outer shelf waters off Townsville, rather than in nearshore waters or the Coral Sea.

3.2.2.2 Vertical Distributions

Based on just three studies (Powles 1977, Leis 1986, Leis and Goldman unpub. 3), lutjanid larvae, at least in relatively shallow coastal waters (appear to prefer the greatest available depth during the day and to migrate upward at night, to a uniform vertical distribution. In contrast, greatest catches of pre-settlement lutjanids have been taken from deep light-traps set close to the bottom (Doherty unpubl. data).

3.2.2.3 Seasonality

In shallow waters in the immediate vicinity of reefs of the GBR lagoon, lutjanid larvae were present year-round but were most abundant in spring and summer (Leis 1982, 1986). In more open, deeper waters of the GBR lagoon, highest abundances were found in summer (Leis 1987). Williams et al. (1988) sampled ichthyoplankton in the central GBR every 2 weeks from late January to late March and found maximum concentrations of lutjanid larvae in the late February and mid-March collections. Light-trap collections of pelagic juveniles show a similar distribution, with good catches recorded in Nov./Dec./Jan. (Doherty unpubl. data).

3.2.2.4 Growth and Length of Larval Period

The only significant data on growth rates of a larval lutjanid are for laboratory-reared specimens of the Tropical-Western Atlantic species *L. griseus* and the Indo-Pacific *L. johnii* (Lim et al. 1985). Larvae of *L. johnii* metamorphose at 30 to 35 days under laboratory conditions (Lim et al. 1985). Size at settlement seems to vary considerably with species. *L. vitta* settles at about 30mm (Mori 1984), and most pelagic lutjanids taken by light-traps are at least this size (Doherty unpubl. data); however *L. griseus* appears to settle as small as 10mm in sea-grass beds (Starck 1970). The duration of the pelagic period of lutjanids has been directly measured only three times (*L. fulvus*, *L. griseus* and unidentified spp.) and ranged from 25 to 47 days.

3.3 Plectropomus spp.

3.3.1 Descriptions and Identification of Larvae and Eggs

The eggs of *Plectropomus* have not been described but those of three other genera of epinepheline serranids are pelagic, with a smooth chorion, unsegmented yolk and a diameter of 0.75 to 1.20mm (Leis 1987). A single colourless-to-slightly-yellowish oil droplet of 0.13 to 0.22mm diameter is present. Incubation takes from 20 to 45 hours (Leis 1987).

Plectropomus larvae are identified as epinepheline serranids by their characteristic head spination, kite-shaped body and elongate, ornamental dorsal and pelvic spines. Larger (Australian) larvae are identified as *Plectropomus* by their fin meristics, particularly the dorsal fin counts of VIII, 11 and a single predorsal bone (Leis 1986).

More complete species-specific identifications exist for *Plectropomus* spp. than for any other genus of commercial or recreational interest on the GBR. Characters used include tail pigment, structure of the pelvic spine and head spination. Details are given in Leis (1986).

3.3.2 Ecological Information

Although epinepheline larvae have been recognised for a longer time than lutjanid larvae, no more is known of their early life history than that of lutjanids (Leis 1987).

3.3.2.1 Horizontal Distributions

The limited available data indicate that the cross-shelf distributions of *Plectropomus* larvae are similar to the distributions of the adults. The following comments refer to those specimens examined by Leis (1986). *P. maculatus* larvae were generally captured closer to the shore than were larvae of *P. leopardus*. The distribution of *P. leopardus* larvae was 'generally consistent with the adult distribution' i.e. 'most abundant on mid-reefs and less abundant on outer barrier reefs and inshore reefs' (Hoese et al. 1981). All five *P. laevis* larvae collected by Leis were taken along the edge of the GBR continental shelf in the Coral Sea. Leis did not collect any larvae of *P. areolatus* from the GBR. Epinepheline larvae (including *Plectropomus*) do not appear to remain in the immediate vicinity (i.e. 100 to 200m) of reefs or to disperse large distances in the offshore direction from the adult habitat (Leis 1987).

3.3.2.2 Vertical Distributions

Very little data is available on the vertical distributions of larvae of *Plectropomus* spp.. Leis (1987) suggests that they prefer mid-depths, at least in a study of vertical distributions in 25m of water off Lizard Is.. During the day no *Plectropomus* larvae were found in the neuston and only one in the 0 to 6m stratum, but eight were found in the 6 to 13m stratum and four in the 13 to 20m stratum. Only a single *Plectropomus* larva was taken at night, in 6 to 13m (Leis 1987). Pelagic juveniles of *Plectropomus leopardus* have been caught in both shallow (1m) and deep (20m) light-traps set at Arlington Reef, Cairns Section (Doherty unpubl. data), with greatest catches near the surface.

3.3.2.3 Seasonality

Off Lizard Island, *Plectropomus* larvae were more abundant in summer than at any other time (Leis 1987). Pre-settlement coral trout have been caught in light-traps in all months from October to January, apparently sourced from reproduction during the previous month (Doherty unpubl. data).

3.3.2.4 Growth and length of Larval Period

Larvae of *Plectropomus* apparently settle at about 20mm (Leis 1987). A. Fowler (pers. comm.) has determined the mean duration of the pre-settlement stage of *P. leopardus* as 25.2d +/- 0.46 (SE), based on otoliths of 38 newly settled fish collected from Arlington Reef off Cairns.

3.4 Recruitment Variability

Understanding natural variability in rates of replenishment (or recruitment) of fish to reef populations is critical for interpreting among- and within-reef variability in fish density. It is also critical in determining reef-specific responses to disturbance such as fishing. A great deal has been learnt of natural variability in rates of replenishment of reef fishes over the last 10 to 15 years (reviewed in Doherty and Williams 1988). Long-term monitoring of reef fish recruitment in the central and southern GBR (since 1981) has (1) identified regional differences in recruitment dynamics, (2) shown that within regions significant variability in year-class formation among reefs is generated by transient pulses of a few days, possibly associated with patches of larval fish and (3) shown that variations in year-class strength among reefs can be preserved in the age structure of demersal populations and may affect abundance for at least a decade (Doherty and Fowler, in press).

None of these studies of reef fish recruitment have concerned species of commercial or recreational importance simply because newly settled individuals of these species are not often encountered by SCUBA divers. Recent studies have shown that a more effective means of quantifying variability in replenishment of species with cryptic, pelagic or rare juveniles is to sample the pre-settlement stages using light-traps (Doherty 1987).

A cross-shelf study of larval fish off Townsville using light-traps (started in 1988/89) has identified nearshore nursery areas for all of the common mackerels and suggested substantial interannual variability in larval abundance of these species. Such variability has been shown even more clearly in a FIRDC-funded coral trout study including light-trapping at Green Island and Arlington Reefs off Cairns. In 1990/91, replenishment of coral trout (*P. leopardus*) populations on Green and Arlington reefs was restricted to a single 3 week period around the new moon in November. Work in progress indicates that recruitment at the same sites in 1991/92 will consist of 3 or 4 monthly episodes. In both years, the periodicity of the larval catches has been validated by comparisons with back-calculated settlement dates from collections of newly-settled juveniles (P. Doherty, pers. comm.). Monitoring of spawning activity on adjacent reefs by QDPI suggests that these temporal patterns in recruitment are related to reproductive activity and occur at least over regional scales.

The light-trap program off Cairns has further revealed consistent differences in larval supply between adjacent reefs which may be related to reef topography or different dispersal paths to these reefs. Further elucidation of these patterns will be an important consideration in designing experiments on the effects of fishing. Confounding different experimental treatments with fixed and unknown differences in replenishment rates among reefs could seriously compromise the power of most experimental work (P. Doherty, pers. comm.).

3.5 Studies in Progress

(i) Leis at the Australian Museum is carrying out a taxonomic study of larval lutjanids.

(ii) Doherty at AIMS is monitoring the distribution of pelagic juvenile fish along a 160km cross-shelf transect off Townsville using light-traps. Catches include large numbers of lethrinids, relatively few *Lutjanus* and *Plectropomus.*

(iii) Doherty is also monitoring pelagic juvenile fish and recruitment in a second light-trap study based at Arlington and Green Reefs, Cairns Section. This is part of a larger joint study (QDPI-AIMS-JCU) into the biology of *Plectropomus leopardus* and *Lethrinus miniatus* that has been funded by FIRDC.