**Demersal sharks**

**Port Jackson (Heterodontus portusjacksoni)**

**Occurence**: live on rocky reefs close to the coast. They can be found down to depths of 275 m.

**Diet**: They eat small bony fishes, crabs, lobsters, octopuses, molluscs, crustaceans and sea urchins (Powter et al, 2010)

**Adult:** mainly *Octopus. tetricus*, Loliginidae and Pleuronectiformes (flatfish) 10%, Scorpeniformes 7%, Percoformes 6%, **demersal prey and pelagic prey, tertiary consumers**

**Subadult**: mainly molluscs, echuroids, Decapoda 26.3%, Diogenidae (hermit crabs), squid, Scorpaeniformes 6.8%, Clupeiformes 3%, Perciformes 5.2%, , Pleuronectiformes; **benthic infauna, benthic epifauna, demersal benthic, secondary consumers**

**Juvenile:** Decapoda - crabs (32%), Molluscs (6%), small fish (29%) – (Pleuronectiformes, clupeiformes), echiuroidea (24%), echinoderms, mainly molluscs, Anguiliformes (eels), echuroids, by ecological group: **benthic infauna, benthic epifauna, demersal benthic, secondary consumers**

**Grey nurse Carcharias taurus**

**Occurence:** shallow coastal waters from the surf zone down to 60 m, although it has been recorded from water as deep as 190 m. usually found in the vicinity of dropoffs, caves and ledges. coastal species found on the continental shelf from the surf zone down to at least 190 m (Compagno 1984, Klippel 1992, Last & Stevens 1994). The shark is a slow, strong-swimming species that is often seen hovering motionless near the bottom in or near deep sandy-bottomed gutters or in rocky caves around inshore rocky reefs and islands at depths between 15 and 25 meters (Goadby 1968, Grant 1982, Pollard *et al*. 1996, Cliff unpubl. ms., Otway & Parker 2000). Occasionally, they are also found throughout the water column (Compagno 1984). The shark is thought to be more active at night (Compagno 1984, Pollard *et al*. 1996)

**Diet:** feed on fishes, which are pierced with the sharp teeth. In Australian waters, it is likely that the diet consists of pilchards, jewfish, tailor, bonito, morays, blue groper, sea mullet, flatheads, yellowtail kingfish, small and juvenile sharks, squid and possibly some crustaceans. This will need to be verified by gut content analysis of incidentally caught and killed grey nurse sharks. It is important to note that many of the species that comprise the sharks’ diet are also harvested by commercial (e.g. Gray & Otway 1994, Otway *et al*. 1996) and recreational fishers.

**Life-history Stage Rate of Growth(cm/year) Age(years)**

Pup 25-30 0 - 1

Juvenile 20-25 2 - 3

Juvenile/ Sub adult 15-20 4 - 5

Adult/Adult 10-15 6 - 7

Adult 5-10 > 8

(After: Branstetter & Musick, 1994).

While the instantaneous rates of natural mortality of the grey nurse sharks have

estimated by several authors (e.g. 12.9% p.a. - Smith *et al*. 1998, 15.43% p.a. - Mollet

2000) using the equations of Pauly (1980) or Hoenig (1983), there are few, if any, empirically derived estimates of natural mortality.

**Natural Predators** Past research in South Africa (e.g. Bass *et al.* 1973, Bass *et al.* 1975, Cliff *et al.* 1989 1990, Cliff & Dudley 1991) has shown that the great white shark (*Carcharodon carcharias*), short-finned mako (*Isurus oxyrinchus*), the tiger shark (*Galeocerdo cuvier*) and bull shark (*Carcharhinus leucas*), consume a range of small sharks (< 1 m precaudal length) and the juveniles of larger sharks including the grey nurse shark.

Analysis of the gut contents of these 4 species caught in SE Australian waters

(Stevens 1984, Last & Stevens 1994) has also shown that of small sharks and the

juveniles of larger sharks are also prevalent in their diets. Moreover, the

distributions of great white, short-finned mako, tiger and bull shark (Stevens 1984,

Pepperell 1992, Reid & Krogh 1992, Krogh 1994, Last & Stevens 1994, Otway unpubl.

data) overlap the present distribution of the grey nurse in NSW waters (Last &

Stevens 1994, Otway & Parker 2000). Consequently, it would be reasonable to

hypothesise that these 4 species are the most likely natural predators of the grey nurse shark.

**School shark** ***Galeorhinus galeus***

**Occurence:** In Australia, pups are born 30 cm long and adults grow to 175 cm long (Last & Stevens 1994). In the North Atlantic, adults regularly grow to 195 cm long (Last & Stevens, 1994). The average weight of this species is 6–12 kg with a maximum weight of 33 kg (Daley et al. 2002a).

It is primarily a deep water demersal (bottom-dwelling) species, although individuals have been recorded undertaking daily vertical migrations, remaining at depths of around 500 metres during the day and moving up to around 100 metres at night (McLoughlin 2007). Females and juveniles utilise inshore coastal areas around Victoria, Tasmania and parts of South Australia for nursery areas (Pogonoski et al. 2002).

School Sharks depend on inshore nursery areas (shallow sheltered bays, estuaries and inlets) as habitat for females giving birth and for juveniles. Pups in such habitat feed on a variety of mainly seagrass associated fauna in the sediment (Olsen 1954; Walker et al. 2005). The most important pupping areas identified were around Tasmania, particularly in the south-east, and in Victoria, including Port Phillip Bay, Western Port Bay and Corner Inlet (AFMA 2009d). This preferred birthing habitat makes this species vulnerable to predation, fishing, habitat destruction and pollution (Olsen 1954; Walker et al. 2005).

Males attain sexual maturity at 125–135 cm, and females at between 134–140 cm (Stevens 2005). Maturity is estimated to occur at 10 years with reproduction occurring every 2–3 years (Fenton 2001; Stevens 2005; TSSC 2009b). Life expectancy is estimated to be more than 55 years (Fenton 2001; Stevens 2005). In the absence of fishing, mortality is expected to be low, with a natural mortality rate of about 0.10–0.26 (Stevens 2005).

Female School Sharks give birth to 15–43 pups (average 26, maximum 54) at 30–35 cm in length (Stevens 2005; TSSC 2009b). The young develop within eggs that remain within the mother's body until they hatch, when they emerge as live young (ovoviviparous). Pups are born in spring or summer (in December and January off southern Australia), after a gestation period of 12 months (McLoughlin 2007; Pogonoski et al. 2002; Stevens 2005). In Australia, females are reported to breed every second year.

**Diet:** Adult School Sharks are predatory and feed mainly on teleost (ray-finned) fish and bottom-associated species, but may also feed on pelagic species (Stevens 2005). Squid and octopus, as well as other cephalopods are also important constituents of their diet. The diet of juvenile School Shark may include a higher proportion of crustaceans, annelids and gastropods (Stevens 2005).

The School Shark has been identified as a conservation value in the [South-west](http://www.environment.gov.au/coasts/marineplans/south-west/index.html) Marine Region.

In Western Australia it is found from Houtman's Abrolhos south to Cape Leeuwin and thence eastwards as far as Point Culver (F.R.V. Warreen). There is a 400-mile gap between Point Culver and the head of the Bight from which there are no records but there is no reason to assume that school sharks do not occur there.

diet (Olsen, 1954):

**adult:** The stomach contents showed that school sharks had a marked preference for fish and cephalopods (octopus and squid), The remaining 2 per cent of the food was made up of the soft-shelled stages of the spiny lobster, Jasus lulandii. Seventeen species of fish have been identified from the stomachs of school sharks, the predominant ones being barracouta (Thyrsites atun) and jack mackerel ( Trachurus novae-xelundiae Richardson). These two pelagic species apparently frequent the bottom zones at certain times of the year and are then preyed upon by sharks. The other species of fish

found in the gut were nearly all bottom feeders and often restricted to reef conditions.

**Juveniles:** fish and cephalopod component was lower in juveniles (88 per cent.) than in adults (98 per cent.). The juveniles supplemented their diet with annelids, other molluscs, and crustaceans. In the Port Sore11 (Tas.) estuary, crustaceans (crabs) formed the major part of the stomach contents, though for a short period of each year when whitebait (Lovettia seati Johnson) were running the sharks

also fed on these small anadromous fish. The diet of the small sharks in the Pittwater (Tas.) estuary was more diversified and included sandworms, crabs, shrimps, .small fish, and cephalopods. On two occasions the stomach contents yielded a freshly eaten fish which is normally found only around string kelp beds (Macrocystis pyrifera (L.) Agardh), the nearest bed being in Frederick Henry Bay about 15 miles distant from the Pittwater tagging centre. Examination of gut contents from sharks caught near Portarlington (Port Phillip Bay, Vic.) indicated that crabs formed the most important part of their diet. Fish and cephalopods Fish and cephalopods formed the bulk of the juveniles' food but snapping shrimps (Crangon spp.), sandworms, and the foot of the gastropod (Scaphella undulate Lamarck) were often found in the gut. The most commonly found food fish of the juvenile sharks were the anchovy (Engraulis australis Shaw), followed by the small cod (Physiculus barbatus Gunther) and a viviparous goby (A~enogobius bifrenutus Kner). Also blenny, flounder occasionally.

**Gummy shark Mustelus antarcticusc**

**Occurrence**: occurs in temperate waters from northern New South Wales to south-western Western Australia. The species grows to a length of 1.75 m.

**Diet:** mostly cepahalopods and crustaceans and occasionally bony fish

**The diets of dusky (*Carcharhinus obscurus*), whiskery (*Furgaleus macki*) and gummy (*Mustelus antarcticus*) sharks** (Simpfendorfer et al, 2001)

***Carcharhinus obscurus***had a diverse diet dominated by pelagic teleosts 57% and cephalopods 51%, Elasmobranchs 2%. 22 of the 26 families of teleosts identified were considered demersal or benthic. A wide range of demersal and benthic prey were also consumed, but represented only a small portion of the diet. As body size increased, importance of elasmobranchs in the diet of *C*. *obscurus* increased, while most other groups remained at similar levels. The occurrence of the major prey groups (cephalopods and teleosts) did not change substantially between small, medium and large *C*. *obscures.* Crustaceans were recorded only from small animals.

***Furgaleus macki***had a specialized diet, feeding almost exclusively on octopus and other cephalopods.

***Mustelus antarcticus*** dominated by benthic and epibenthic prey, including crabs, lobsters, tetraodontid fishes and octopus. As *M*. *antarcticus* increased in size there was an increase in the occurrence of rock lobster and a decrease in the occurrence of crabs in the diet.

**Pelagic shark adult:**

|  |  |
| --- | --- |
| **prey item** | **probability of consuming** |
| CEP Cephalopod | 0.3 |
| FDC demersal shallow carnivore | 0.2 |
| FMA demersal macroalgal fish | 0.1 |
| FLR large reef associated | 0.1 |
| SD elasmobranches (sharks, rays, skates) | 0.2 |
| RAY (ray) | 0.2 |
| FDO (demersal shallow omnivore) | 0.1 |
| LOB lobster adult | 0.1 |
| Dhu dhufish | 0.01 |
| PKS Pink Snapper | 0.01 |

**Pelagic shark subadult:**

|  |  |
| --- | --- |
| **prey item** | **probability of consuming** |
| MAZ Macrozoobenthos | 0.1 |
| BG Benthic grazers | 0.1 |
| BC Benthic carnivores | 0.1 |
| CEP cephalopod | 0.3 |
| FDT Detrivorous fish | 0.2 |
| PRW prawns | 0.2 |
| LOJ Lobster juvenile | 0.05 |

**Pelagic shark juvenile:**

|  |  |
| --- | --- |
| **prey item** | **probability of consuming** |
| BG Benthic grazers | 0.2 |
| FDT detritivorous fish | 0.1 |
| SAR Sardines | 0.2 |
| FDC (occasionally) demersal shallow carnivore | 0.02 |
| PRW (prawns) | 0.2 |
| CEP cephalopod | 0.3 |
| LOJ lobster juvenile | 0.05 |
| MAZ macrozoobentho | 0.1 |

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