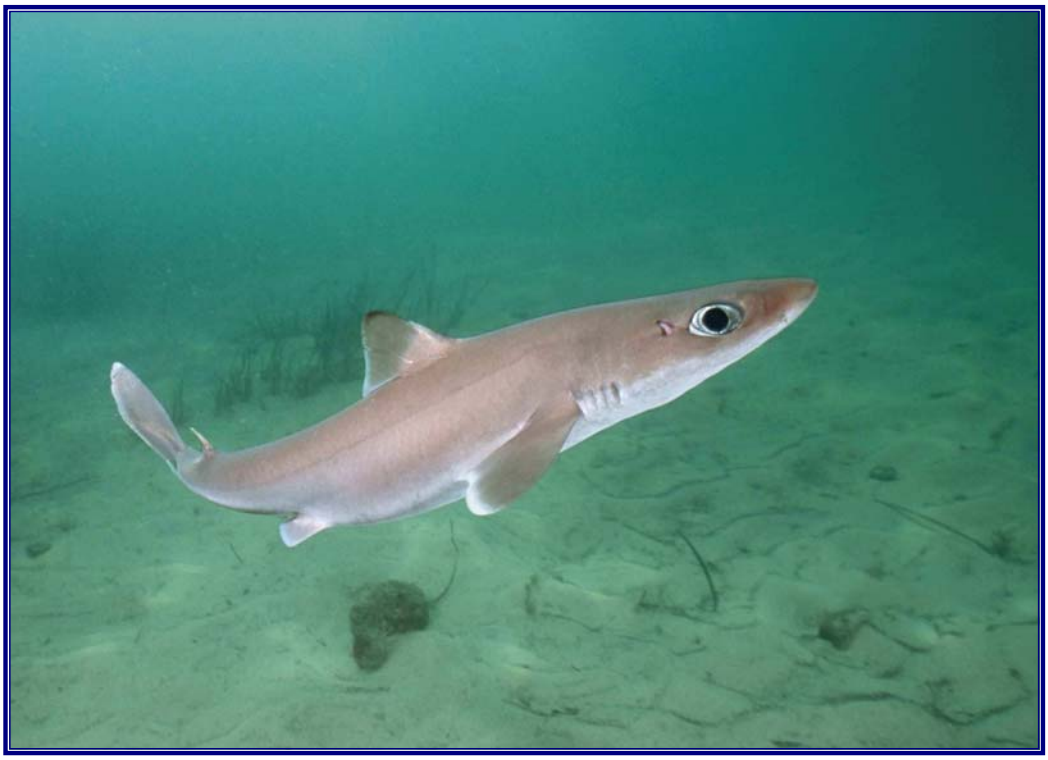
ASSESSMENT OF ECOLOGICAL RISKS FROM EFFECTS OF FISHING TO PIKED SPURDOG (*SQUALUS MEGALOPS*) IN SOUTH-EASTERN AUSTRALIA



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DECLARATION OF AUTHORSHIP

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Cover image: The piked spurdog, *Squalus megalops* (photo by Kelvin Aitken).

CONTENTS

ABSTRACT

Target species in some Australian shark fisheries are adequately managed, but there has been little attention given to non-target shark species and there is limited information on the biology of their local populations. Among this group of non-target species, the piked spurdog (*Squalus megalops*) is of special interest because it is a dominant and ecologically important species with high natural abundance. Hence, the main purpose of the present research was to improve knowledge of the basic biology of this species and to provide essential data for its management, sustainable use and conservation.

Squalus megalops had a complex population structure, segregating by sex, size and breeding condition. The sex ratio was biased towards females and there was sexual size dimorphism with females attaining a larger maximum size than males. Conversion factors from partial lengths to total length and from partial masses to total mass were determined due to the common commercial fishing practice of eviscerating, beheading and finning sharks. Comparisons of total and partial length–length and mass–length relationships between males and females using different ranges of size showed that there was no effect of size range on measurements reflecting only somatic growth (fork and carcass lengths; carcass, pectoral fin and caudal fin masses). However, for variables reflecting somatic and reproductive growth (total and liver masses), different outcomes can be expected when different ranges of size are compared.

Examination of dietary composition revealed that *S. megalops* is an opportunistic predator that consumes a wide range of prey items. High variability was found when overall importance of prey items was estimated. Dietary composition varied in space and time, exhibiting differences among regions, seasons and size classes. Therefore, the intrinsic natural variability in the dietary composition of *S. megalops* and its spatial and temporal variation in diet suggest that information on the ecological relationships among species is likely to be missed when predator–prey interactions are only inferred from overall diet.

Reproductive parameters were determined for population assessment. For both sexes, length-at-maturity differed depending on the criterion adopted for defining maturity. Mature males are capable of mating throughout the year. Females have a continuous

asynchronous reproductive cycle. The sex ratio of embryos is 1:1 and litter size and near-term embryo size increase with maternal length. Females have an ovarian cycle and gestation period of two years. Although all females are mature at 600 mm, only 50% of them are in maternal condition, contributing to annual recruitment each year. Hence, for chondrichthyan species with reproductive cycles of two, three or more years, if maturity ogives are used in population assessments instead of maternity ogives, the models will over-estimate recruitment rates.

Age and growth information was also determined for population assessment. Precision estimates, the relationship between spine total length and body length, edge analysis, and agreement between counts on the inner dentine layer and the enameled surface support the use of the first dorsal fin spine for the age estimation of *S. megalops*. Based on goodness-of-fit criterion, the best growth model for males and females was a two-phase von Bertalanffy function. However, model selection cannot be based on quality of statistical fit only and results should be interpreted with caution. Regardless of the model used, the growth rate of *S. megalops*, particularly of females, is very low, even within the range of growth rates reported for shark species.

A three-levelled hierarchical risk assessment approach was trialed to evaluate the suitability of the approach for *S. megalops*. Integration of qualitative, semi-quantitative, and quantitative biological and fishing impact data showed that *S. megalops* is potentially highly susceptible to the effects of fishing. A qualitative assessment indicated that the only fishing related activities to have moderate or high impact on *S. megalops* were those associated with ‘capture fishing’ of the otter trawl, Danish seine, gillnet and automatic longline methods. A semi-quantitative assessment ranked *S. megalops* at risk because of its low biological productivity and, possibly, its catch susceptibility from cumulative effects across the separate fishing methods. Finally, a quantitative assessment showed that population growth is slow even under the assumption of density-dependent compensation where the fishing mortality rate equals the natural mortality rate. Therefore, conservation and management for sustainable use of *S. megalops* will require a close control of fishing mortality due to the low capacity of this species to withstand fishing pressure.

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The piked spurdog, *Squalus megalops* (photo by Kelvin Aitken).