EARLY LIFE HISTORY OF SPINY LOBSTER

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ABSTRACT

Spiny (rock) lobsters are the basis of important fisheries in all of the world's major oceans. We synthesize current information on their early life history from a variety of biological disciplines and draw conclusions about the significance of this phase in the ecology of the group. Larval behaviour is still poorly understood and the scale of larval dispersal conjectural. However, recruitment processes in some shallow-water species, including effects of the environment on these processes, are becoming clearer. Field and laboratory studies have increased our understanding of phyllosoma larval development and behaviour. Our knowledge of the puerulus stage has increased dramatically, particularly concerning behaviour from studies using collectors to measure settlement and through laboratory experiment. Discovery of the habitat of young juveniles has led to examination of relationships between puerulus abundance at sea, levels of puerulus settlement, and the abundance of juveniles and recruits.

RÉSUMÉ

Les langoustes sont à la base d'importantes pêcheries dans tous les grands océans du monde. Nous faisons la synthèse des informations actuelles sur leur vie aux premiers stades à partir de diverses disciplines biologiques et tirons les conclusions sur la signification de cette phase dans l'écologie du groupe. Le comportement larvaire est encore peu compris et l'échelle de la dispersion larvaire conjecturelle. Cependant, les processus de recrutement chez certaines espèces d'eaux peu profondes, y compris les effets de l'environnement sur ces processus, deviennent plus clairs. Les études, aussi bien sur le terrain qu'au laboratoire, ont accru notre compréhension du développement et du comportement de la larve phyllosome. Notre connaissance du stade puerulus a considérablement augmenté, en particulier dans le domaine du comportement à partir d'études utilisant des collecteurs pour mesurer la sédentarisation et au moyen d'expérimentations au laboratoire. La découverte de l'habitat des jeunes juvéniles a conduit à un nouvel examen des relations entre abondance en mer des pueruli, niveaux de sédentarisation de ces derniers et abondance des juvéniles et recrues.

INTRODUCTION

Spiny (rock) lobsters (Palinuridae) form major fisheries in tropical to temperate areas of the world's major oceans. Many species are fully or over exploited. The commercial, recreational, and traditional value of spiny lobsters in many countries has led to considerable scientific study, particularly of Panulirus and Jasus spp., with much of it aimed at more effective management of stocks.
Early life history of spiny lobsters was reviewed by Kanciruk (1980), Lyons (1980a), and Phillips & Sastry (1980). The larval stages of spiny lobster are adapted to a long life in the open ocean and offer opportunity for wide dispersal. Early development comprises larval (naupliosoma in * Jasus* spp. and phyllosoma) stages and a puerulus stage. The naupliosoma is a short-lived (hours) and small (1-2 mm long), recently-hatched prezoea (see Gore, 1985). The phyllosoma is the long-lived (months), leaf-like, transparent, planktonic zoea which in some species reaches 50 mm in length; phyllosoma instars are usually also grouped into stages, based on development. The phyllosoma appears to be a poor horizontal swimmer but swims more strongly vertically. After many months developing in offshore, oceanic waters, some phyllosomas return towards the coast where metamorphosis to the puerulus stage takes place. The puerulus is the postlarva (postzoea) transitional between the phyllosoma and the juvenile, and as a stronger swimmer completes the oceanic phase. It resembles the adult but is transparent and in most species around 8 mm carapace length (CL). The puerulus moults to the first moult postpuerulus (PP) juvenile a few days to weeks after settlement. The number of phyllosoma stages, length of larval life, and duration of the puerulus stage for some species, from field and laboratory studies, are given in table I.

The combination of these two early life history stages has contributed to the group occupying most temperate and tropical regions of the world (Phillips & McWilliam, 1986). But the prolonged larval life has been a major obstacle to spiny lobster fishery research and management; this fascinating aspect of the early life history of spiny lobsters has only recently been understood in any detail.

This review of spiny lobster early life history focuses on findings made since the 1980 reviews cited above. Most information concerns the major commercial, shallow-water species (particularly *Panulirus* and *Jasus* spp.) which make up about 25% of spiny lobster species. Little is known of the less abundant shallow-water species (e.g., *Panulirus stimpsoni* Holthuis, 1963) and deepwater species (e.g., *Projasus parkeri* (Stebbing, 1902)), so we deal only with shallow-water spiny lobsters unless otherwise stated. We first review relevant aspects of reproduction, and then focus on larval and puerulus ecology and larval recruitment processes.

**REPRODUCTION**

Spiny lobsters carry broods of eggs during breeding seasons which are a few months long in most temperate and subtropical species (Chubb, 1994; Kittaka & MacDiarmid, 1994), but in some, mainly tropical, species (e.g., *Panulirus longipes longipes* (A. Milne Edwards, 1868), cf. Gomez et al., 1994), individuals may breed several times a year. Webber & Booth (1988) reported deepwater *P. parkeri* with external eggs most of the year. The high fecundity of spiny lobsters...