

New Zealand Blackfoot Abalone (Pāua): Background, Biology, and Fishery Management

Background and appearance

The New Zealand Blackfoot abalone (*Haliotis iris*, pāua) is a large marine mollusc and one of 58 abalone species throughout the world. It is one of three endemic abalone species that occurs only in New Zealand, along with the smaller yellow-foot and white-foot abalone (*H. australis*, *H. virginia*).

Pāua are well-adapted to life in the harsh coastal zone, having thick oval shells that protect them from strong waves and predation. The exterior of pāua shells are rough and often encrusted with pink algae, but the interior is iridescent with brilliant green, blue and pink hues. Attached to the inside of the shell is the snail-like pāua, which has specialized teeth to chew up seaweed, a rudimentary heart and circulatory system, and a strong muscular foot to clamp firmly to rock. The foot is highly valued by predators and humans alike as a protein source.

Ecology



Pāua play important roles in New Zealand's coastal ecosystem. They are an abundant large grazer on rocky subtidal reefs, where they feed on drift algae and play a role in food web dynamics. Juvenile pāua are a valuable prey item for many predators including sea stars, lobster, and fish.

There is evidence that pāua aggregations help maintain subtidal habitat complexity.

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Reproduction, lifecycle, and growth

Pāua are well-studied, and much is known about their lifecycle, growth and distribution. They are dioecious (i.e. males and females), and take around 3-5 years to reach maturity, depending on region. Pāua reproduce through broadcast spawning, where individuals release sperm or eggs into the water column to meet and fertilise. Spawning is thought to be cued by changes in temperature, photoperiod, or in rare cases natural disturbance such as earthquakes or tsunamis. The timing of spawning events is unpredictable and can occur any time of year or not at all.

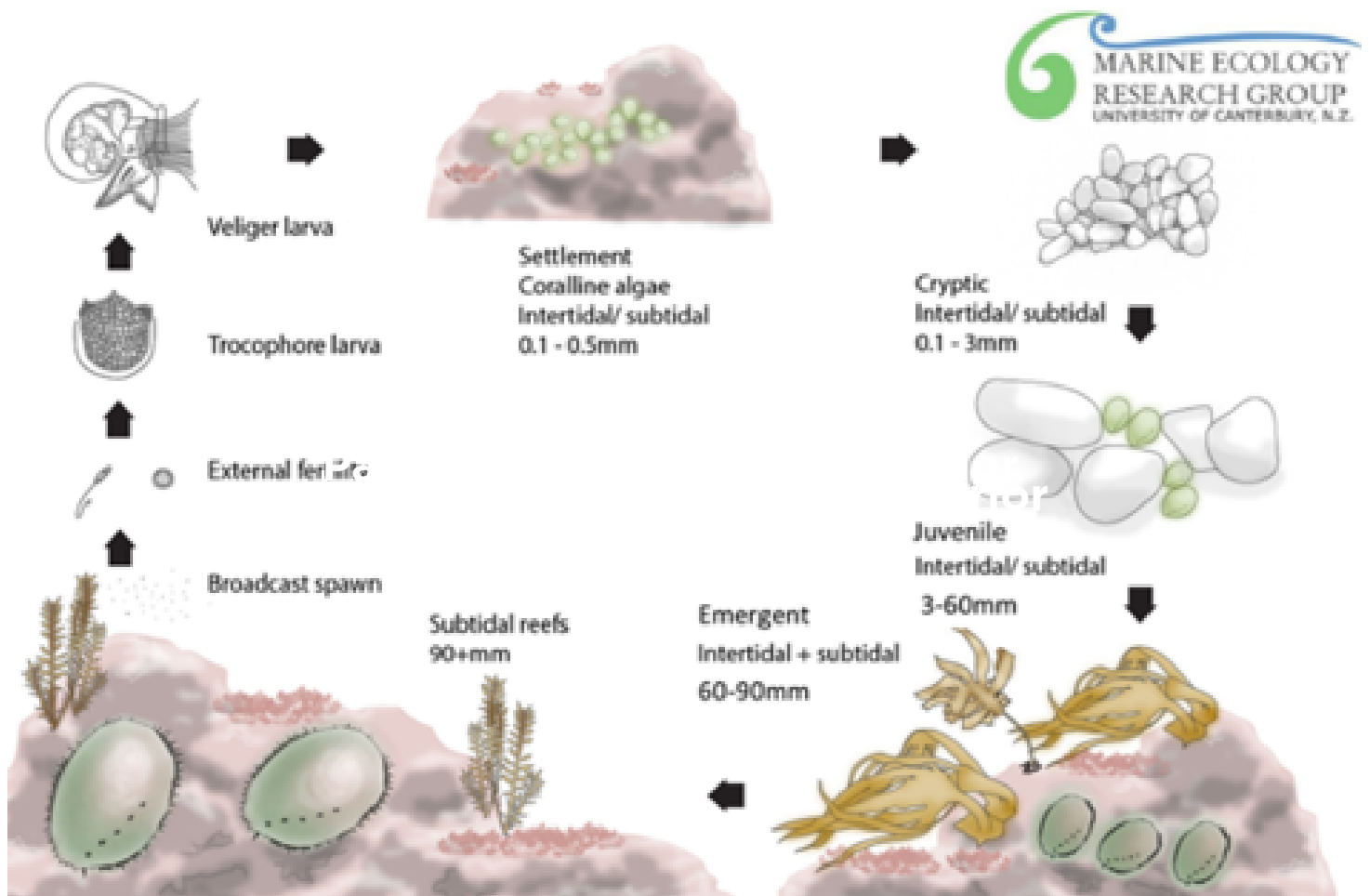
Due to the limited dispersal of sperm and eggs, pāua require proximity of males and females for successful fertilisation, and so exhibit aggregating behaviour when spawning. After fertilisation, lecithotrophic (self-feeding) larvae have about 10 days to disperse prior to settlement, which is linked to chemical cues from specific algal crusts at settlement sites. Pāua larvae primarily settle onto rocky surfaces in the very low intertidal and shallow subtidal zones.

After settlement, post-larvae and juveniles live in cryptic (hidden) spaces beneath rocks for around three years to avoid predation. Pāua begin to mature at 70-100 mm shell length, when they emerge from cryptic habitats, migrate to deeper reefs and join the adult population. Small (5-10 mm) juveniles graze on diatom films, bacteria, and algal crusts before progressing to macroalgae, whereas adults feed by trapping drifting algae with their shell. Pāua can eat a variety of seaweeds but prefer softer brown and red algae.

Growth varies greatly, depending on a range of factors such as temperature, food availability, and pāua density. Pāua grow about 25 mm yr⁻¹ on average, but growth decreases with increasing shell size. In most regions of New Zealand it takes roughly 7-8 years for a pāua to settle from larvae, grow and reach harvestable size (the recreational minimum legal size is 125 mm shell length in most regions, although commercial fishers often fish at much larger sizes). Maximum length for pāua is highly variable depending on their environment, but they can reach over 200 mm in length in optimal habitats, making them the largest of the NZ abalones.

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Pāua Lifecycle



Distribution

Juvenile pāua are shallow-dwelling and live under rocks in less than around 3 m depth, whereas adults are found predominantly on open reefs at greater depths of 3-12 m. Most pāua live at less than 6 m depth, although have been found up to 20 m. The best pāua habitats have complex rocky reef, a supply of drift algae, and wave energy to break up algae and oxygenate the water. Pāua are found all around coastal New Zealand and the surrounding islands, and can tolerate a range of ocean temperatures up to about 21 C. However, the largest pāua and most productive populations occur in colder, wave-exposed areas, as their optimal temperature is around 16 C. In the warmer northern extent of their range, pāua do not tend to reach sizes greater than 120-125 mm. Excessively warm water causes physiological stress to pāua and reduces growth and reproductive potential.



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The Pāua Fishery

The New Zealand abalone fishery centres on the blackfoot pāua because of its large size and general abundance. Pāua have high cultural, recreational and commercial value. They are considered a taonga (treasured) and cultural keystone species for Māori people and have been collected and revered for centuries for their food value and shell. Pāua shells have long been valued for ornamentation, carvings, and tools such as fishing lures. Recreationally, pāua are collected around the country by avid sport divers in search of wild-sourced food and the prized shells. Commercially, pāua comprise a high value export fishery estimated at NZ\$58 million per annum, with high indirect and induced economic value (e.g. processing facilities).

The pāua fishery in New Zealand is managed over 11 geographically defined quota management areas (QMAs). The harvest is regulated by total allowable catch (TAC) in tonnes for each QMA, which is subdivided and allocated across the customary, recreational and commercial sectors, and can be adjusted based on stock assessments. Various regulatory controls apply to each sector, but the recreational fishery is the only one without catch reporting requirements, so there is much uncertainty about recreational harvest rates.

The sustainable management of pāua has become increasingly challenging. Exports of New Zealand wild caught shellfish such as pāua are expected to increase as global demand rises and international fisheries continue to struggle. As the New Zealand population increases, the recreational fishery has grown considerably, and is now one of the largest per capita in the world. This is placing increasing strain on the pāua population, especially around urban centres or areas with easy access.

As a result of these challenges there are few commercially viable wild abalone fisheries left in the world, many of which have undergone extensive closures or costly rehabilitation periods, often with limited success. The few abalone populations that still support significant fisheries are located in remote regions of the globe with relatively short histories of intensive harvest, including South Africa, Southern Australia, and Southern New Zealand. As such, the New Zealand abalone supports one of the last sustainable wild abalone fisheries in the world.

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Managing the Commercial Pāua Fishery

The commercial pāua fishery is highly regulated and employs a range of sustainability measures implemented by Fisheries New Zealand and the commercial fishing industry. For most of New Zealand, commercial pāua divers freedive (no assisted breathing) while hand harvesting their catch, so there is no bycatch or habitat disturbance. There is stringent catch reporting and fishing is ceased when the quota is reached each season.



A commercial pāua diver in action, holding breath and hand-gathering pāua (Photo: Toby Hille)



A scientist diving to assess the pāua population in the remote Chatham Islands.

The commercial sector invests in science and stock monitoring and employ a range of tactics to enhance the productivity of the fishery. These include catch spreading efforts, where fishing effort is spread over large geographic areas to minimize the risk of localized depletion. Commercial fishers adjust their minimum harvest sizes (MHS) to what is biologically appropriate for the area in order to maximize reproductive potential of the stock. For example, in some fast-growing habitats, divers harvest at a minimum of 145 mm or larger, leaving much broodstock behind to reproduce.

The commercial sector also invests in stock enhancement efforts if there are signs the fishery is declining. These may include the translocation of pāua from slow-growing areas into optimal habitats in order to create new spawning banks and increase growth. The reseedling of hatchery-raised juvenile pāua has also been used in areas that have been depleted. For example, after the devastating 2016 Kaikoura earthquake, which destroyed much habitat and caused high pāua mortality, commercial divers released 167,000 hatchery-raised juvenile pāua into natural habitats to speed recovery.

Many of the management initiatives undertaken by the industry are informed by a scientific monitoring programme. Here, scientists freedive around the country to assess the habitats and pāua populations, and make recommendations on how best to achieve a healthy stock levels. The overall goal is to manage for a widespread and highly productive pāua fishery for generations to come.