

New Caledonia. 'What's more, of the 1,200 species of holothurians, the 12 which are edible do not all have the same biology.' In general, it is known that a toxin, concentrated mainly in its skin, protects it from many predators and that it sometimes allows small fish such as Carapidae (messmate fish or pearlfish) to take shelter in its anus. Its method of reproduction is quite astonishing – both males and females, which are ordinarily content to lie flat, rear up like cobras and swing backwards and forwards while releasing their sexual cells.

Finally, the sea cucumber plays a very important role ecologically. As it moves forward, it ingests

and turns over kilos of sediment from the ocean floor. 'If they were not around to stir up the sediment, it would become more stratified and there would be less oxygen. Less oxygen means that the sediment would be less healthy and thus there would be less food for other animals', explains Conand. In other words, the sea cucumber plays the same role on the seabed that the earthworm plays on land.

A useful but unlucky animal: large quantities must be harvested to supply enough to eat since, in fact, only 10 per cent of the animal, i.e., its thick skin, is eaten.

Sea cucumber dive fishery in Washington State: an update

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The commercial dive fishery for *Parastichopus californicus* in Washington State began in 1971, and was the subject of an article by C. Conand and A. Bradbury in *Beche-de-Mer Bulletin* #3 (1991). This article updates the fishery information for the last three seasons (1991–1993) and summarises catch-and-effort data since 1983, the first year that harvest logbooks were required.

From 1971 to 1986, the fishery was open in all areas. Following signs of overfishing, Washington State Department of Fisheries implemented a rotational harvest from 1987 to 1992. State waters were divided into four areas, each fished for roughly six months followed by a closure of roughly three and a half years.

In 1993, it became apparent that two of the four harvest areas were not as productive as the other two, resulting in catch inequities and economic imbalance. The future of the rotational system was also questioned following legal decisions regarding harvest rights for native American Indian tribes. The rotational system was abandoned midway through the 1993 season, with the fishery returning to an all-State fishery. The pros and cons of rotational management are presently being analysed from biological, legal, and socioeconomic standpoints.

A summary of production and catch per unit of effort (CPUE) since 1983 is given in Figure 1. Catch figures prior to 1988 should be viewed with cau-

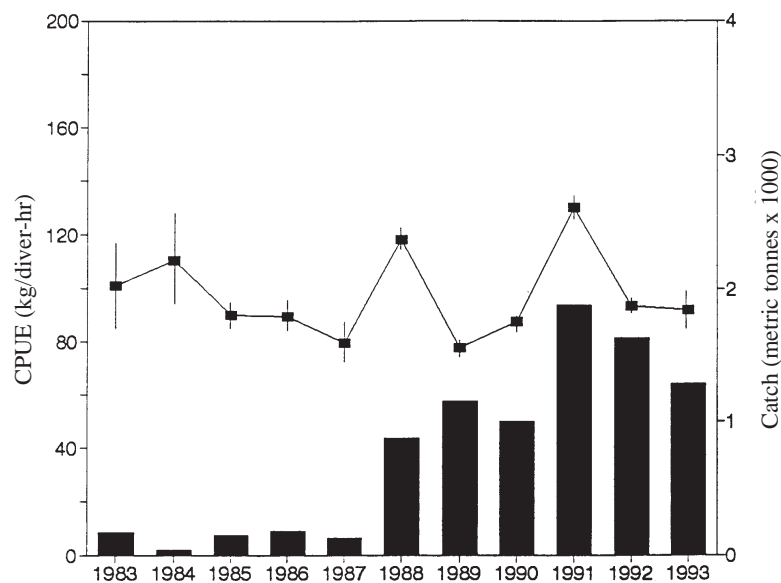


Figure 1. *Parastichopus* catch per unit of effort (line) and catch (bars) since 1983 in Washington State. Vertical bars through CPUE estimates are 95% confidence intervals derived from lognormalised data. Catch refers to tonnes of split, drained, and eviscerated sea cucumbers.

tion, however, due to underreporting. Since 1991, catch has been reduced by roughly 30 per cent with seasonal quotas. These quotas were implemented following signs that recovery of sea cucumber populations at several experimental sites was not sufficient to sustain the fishery at current levels.

State-wide CPUE shown in Figure 1 varies according to the harvest area being fished on the rotational system, but overall appears relatively stable. This apparent stability, however, may be deceptive. CPUE has declined significantly, for instance, in two of the four fishing areas over the past three seasons. Mean harvest depth has also increased significantly in all four areas since 1983, as divers search deeper waters for sea cucumbers. This trend appears to be stabilising recently; mean harvest depth has increased significantly in only one of four districts over the last two seasons.

Value per kg paid to divers at the dock has nearly tripled since 1990. Average price per kg in 1989 and 1990 remained at roughly US\$ 1.32, increasing to US\$ 2.03 in 1991 and to US\$ 2.71 in 1992. Price during the 1993 season was US\$ 3.51 per kg of slit, drained, and eviscerated sea cucumbers.

Several experimental sites have been established to determine the effect that fishing has on *Parastichopus* populations. One of these sites, Pulali Point, has

been surveyed since 1989, during which time two fishing seasons have occurred. Prior to 1989, the area was seldom visited by commercial divers. During each visit to the site, biologists count all harvestable-sized *Parastichopus* within 12 transects, each transect measuring 83.6 m². Four depth zones are surveyed within the site, ranging from 7.6 m to 25.0 m.

Figure 2 shows that the 1990 fishery apparently resulted in a 70 per cent decline in density of harvestable-size animals. During the closed period, which lasted two years and nine months, density fluctuated seasonally (perhaps due to aggregation in the autumn and winter months). Surveys at the site will continue, and data are presently being analysed to estimate rates of mortality (both natural and fishing) and recruitment.

The eventual goal of this research is a yield model for the *Parastichopus* fishery in Washington State. Growth studies are also being carried out with this goal in mind, but these are complicated by several factors: most populations have unimodal size frequency distributions; very small animals are cryptic and apparently suffer high natural mortality; recruitment appears to be episodic in many areas; confined animals do not survive and grow well; and *Parastichopus* sheds conventional plastic tags within a few months.

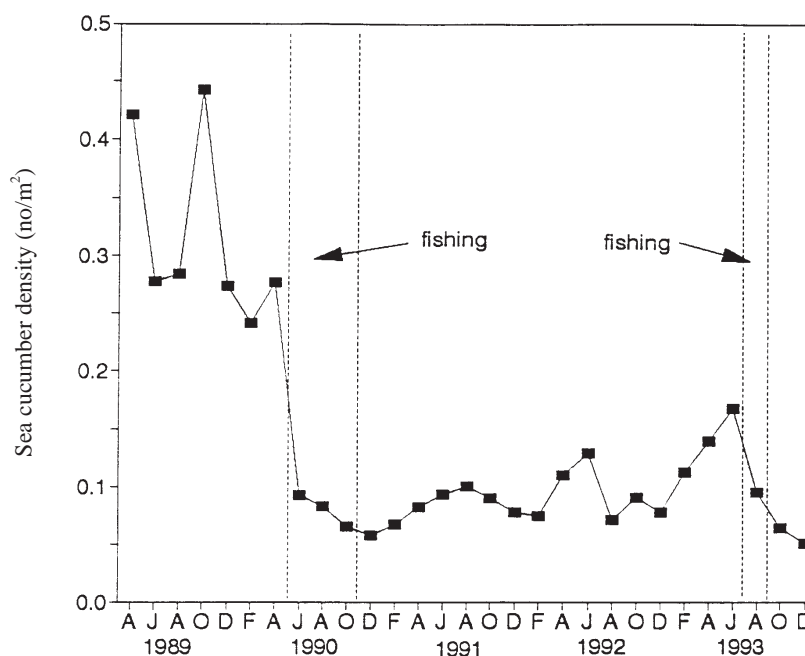


Figure 2. Density of harvestable-sized *Parastichopus* encountered within 12 transects at Pulali Point, Washington State