

The subsistence use of *Stichopus variegatus* (now *S. hermanni*) in the Pacific Islands

by Lyn Lambeth¹

The collection of sea cucumbers for subsistence use and some local sale is widespread in many parts of the Pacific. Various species are eaten fresh, cooked or pickled in lime juice. Some are harvested for the body wall, while other species are harvested for their gonads or intestines. Some commonly used species are: *Actinopyga miliaris*, *A. echinites* and *A. mauritiana*; *Holothuria scabra*, *H. verrucosa* and *H. fuscopunctata*; *Bohadschia argus* and *B. marmorata*; *Thelenota ananas*; *Stichopus horrens* and *S. variegatus* (Conand, 1990; Matthews & Oiterong, 1991; Smith, 1992; Dalzell *et al.*, 1996; Lambeth, 1999).

In the Pacific, the intestines of *Stichopus variegatus*, or curryfish, are collected. Afterwards, the sea cucumber is thrown back onto the reef where it regenerates its internal organs. Although it has rarely been documented or researched, the practice appears to be common in Samoa, Tonga, Cook Islands, Palau, Pohnpei, and probably many other places (Baquie, 1977; Lambeth, 1999; Malm, 1999). The lack of documented knowledge on this can perhaps be attributed to the fact that this is a non-commercial fishery practised by women – an area that has often been overlooked in fisheries research, development and management projects in the region. Added to this is the fact that *S. variegatus* is considered to be of low value to the commercial beche-de-mer industry, due to the tendency of the body wall to fall apart after harvesting and during boiling.

When harvested for subsistence use the intestines of *S. variegatus* are eaten raw on the spot, or squeezed into a bottle to be taken home and eaten. In some places the bottled intestines may be sold locally. The taste is rich, slightly metallic, with a strong but pleasant aftertaste, similar to raw oysters, and is often enjoyed with a little lime juice. Another *Holothuria* sp. is harvested in Tonga and Rarotonga, Cook Islands for the gonads (Baquie, 1977; Malm, 1999). It is widely believed the animal recovers if immediately thrown back into the sea after the body is cut and the gonads and/or intestines are removed.

In some sea cucumbers the ability for local, softening of the connective tissue enables them to

forcibly eject parts of their internal organs or body in response to attack. Others literally melt when attacked – an occurrence many people have experienced when picking up *Stichopus* sp. If the animal is returned to the water immediately this disintegration is reversed.

All echinoderms are able to regenerate arms, visceral and gonadal tissue. Aspidochirote and dendrochirote holothurians are known to eviscerate in response to rough handling, probably as a diversion to predators. Depending on the species, the anterior or posterior end of the animal ruptures and parts of the gut and associated organs are expelled. A seasonal absence of viscera has also been observed in some species and this appears to be caused by atrophy and absorption of the visceral organs, perhaps as well as spontaneous evisceration in some cases (Byrne, 1985). The seasonal loss of visceral organs, either by discharge through the cloaca or internal absorption is, according to Ruppert & Barnes (1994), a normal phenomenon in some species, perhaps initiating a period of inactivity during adverse conditions, or eliminating wastes stored in internal tissues.

Subsistence use of evisceration and regeneration in Palau

Matthews & Oiterong (1991) liken the regular harvesting of *S. variegatus* intestines in Palau to a form of farming. *S. variegatus*, or *ngimes*, in Palau are collected during the morning low tide before the animals have eaten and when the intestines are clean and free of sand. The animal is cut open or sliced in two halves; intestines are removed by shaking the animal and squeezing along the body. The body is then thrown back in the water to regenerate.

It is believed that both halves of the cut sea cucumber will regenerate into a complete organism and the women say that they observe many small individuals in areas where *ngimes* are often collected (Matthews & Oiterong, 1991). Some women prefer to obtain the intestines by just making a small slit in the underside of the animal rather than cutting it in two, believing that cutting the animal in two takes longer for it to regenerate and results in too many

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Figure 1. Collection of *Stichopus variegatus* intestines in Palau



Figure 2. Squeezing a finger into the underside of the body wall is usually enough to cause auto-evisceration.

small *ngimes* (Lambeth, 1999). Other women believe that the intestines taste better if they come from animals recently cut in half. If the *ngimes* from an area have never been harvested by this method, the intestines are said to have a bad aftertaste.

Little or no research has been undertaken on this process of regeneration after the removal of intestines for food in the Pacific. Women in Palau believe the animal regenerates its intestines within a few days. Some studies suggest it takes from 15 to 120 days for temperate water species to regenerate (Byrne, 1985; Bai, 1994). Bai (1994) reported that the tropical species *Holothuria scabra* can begin feeding around seven days after induced evisceration and that the 'rate of regeneration, in all the tissues studied, seems to be more

rapid when compared to that of temperate forms.'

Some research has been undertaken on the ability of sea cucumbers to regenerate into complete organisms from two halves. The potential for asexual propagation through induced transverse fission in several tropical species of sea cucumber, including *S. variegatus*, has been evaluated in the Maldives (Reichenbach & Holloway, 1995; Reichenbach *et al.*, 1996). Transverse fission was induced by placing rubber bands midbody on the sea cucumbers. The studies showed that adult *S. variegatus* (with a median wet weight of 3,650 g) were able to regenerate only the posterior part into a whole animal, in around 100 days, with zero per cent survival of the anterior parts and 80 per cent survival of the posterior parts. In contrast, medium size (median weight 1,300 g) and small (median weight 600 g) animals were able to regenerate both anterior and posterior parts (with 100 per cent survival) into whole animals in around 40 to 80 days. The shortest regeneration time was for the posterior parts of the smallest weight class of *S. variegatus*. The subsistence harvesting of *S. variegatus* observed in Palau and Pohnpei involved animals in the small to medium size range.

Subsistence use of evisceration and regeneration in Pohnpei

In Pohnpei, Federated States of Micronesia, the internal organs of *S. variegatus*, or *werer*, are collected by women in much the same manner as in Palau – being cut in half, or cutting a small slit with a knife, or using the finger to make a hole in the underside to remove the intestines. The sea cucumber is then returned to the water where it regenerates its internal organs after an unknown amount of time. The intestines are collected in the early morning before the animal has started feeding, when there is no sand in the gut, but they may be collected for use as bait at any time. Some people cut the animal with a knife to remove the intestines (as in Palau) but others believe that this can kill the animal and it is better to use the finger to make a hole in the underside. The body wall dissolves around the pressure from the finger and the intestines are then ejected rather than having to be squeezed out.

As in many parts of the Pacific, the women believe that the animal regenerates its intestines overnight,

or at least within a few days, and if the animal is broken in half, both halves will grow into two complete animals. Recently harvested animals appear normal from the outside but contain little or no internal organs. While collecting *werer* intestines for bait in a heavily harvested area, it was observed that most animals had sand in their intestines from feeding all morning, but that there were a few that contained no sand. The women believe that these are the most recently harvested animals, unable to feed, because their intestines are not yet fully regenerated (Lambeth, *in press*).

While the intestines are eaten by both men and women, they are believed to be particularly good for pregnant women and new mothers. As in Palau, the taste of the intestines from the smaller animals or those that have been harvested before are preferred to the taste of those from the larger ones. When used for bait, the intestines are tied to a hook with a hair and are said to be good for catching snapper.

One-litre bottles of intestines are sometimes sold in the local market for around AU\$ 3.00; it takes up to 20 animals to fill a bottle. The intestines are bottled in seawater and are usually sold the same day they are collected. Ice or refrigeration is not used.

Stichopus japonicus intestines – a Japanese delicacy

In Japan, an expensive fermented delicacy, *konowata*, is prepared from the visceral mass of *Stichopus japonicus* (Tanikawa, 1985; Conand, 1990).

The intestines are obtained as a by-product of the processing of this sea cucumber for its body wall and is, therefore, unlike the Pacific Island renewable use of *S. variegatus*. In the preparation of *konowata*, the visceral mass (alimentary canal and reproductive organs) is washed, drained in a bamboo basket, and then salted. Once drained it is placed in a barrel, covered and stirred occasionally during one week of fermentation. The finished product is sold in small glass bottles that last without spoilage over several weeks (Tanikawa, 1985). *Konowata* is used as an accompaniment with drinks and sells for around AU\$ 100 for a 65 g jar (Morgan & Archer, 1999).

Traditional knowledge and resource management

The traditional environmental knowledge of Pacific Island people has been gained through centuries of practical experience and has often been used to effectively manage their marine resources. The beliefs and harvesting practices that have evolved based on the unusual biology of *S. variegatus* are an interesting example of this. In Palau, the collection of *ngimes* only during morning low tide was an effective management measure. Morning low tide meant the animals were in shallow water, easily accessible to the women, and the intestines were free of sand. It also meant they were only harvested over four mornings, twice a month, leaving around 10 days between harvesting trips – which was, according to the women, more than enough time for the internal organs to regenerate. In



Figure 3.

Collecting intestines in the afternoon to use as bait.



Figure 4.

Bottled intestines for sale in Kolonia, Pohnpei.

Pohnpei, the preference of using a finger to cause the animal to slightly disintegrate the body wall and auto-eviscerate, rather than cutting or halving the animal, could conceivably lead to less trauma, greater survival and faster regeneration times.

Today, an increasing human population and the development of the cash economy are leading to overharvesting in some areas, especially around the main urban centres. The sale of intestines in the local markets has meant there is now a greater incentive to harvest more than an individual or family would normally eat. The increase in the number of people in formal employment has led to a market for what was previously only a subsistence food. Those in full-time jobs have little time for reef gleaning or fishing, but are able to pay others to provide the local foods they enjoy.

In Samoa a number of villages, concerned about harvesting practices for sea cucumbers, have banned the collection of *S. variegatus* for removal of the intestines away from the place of harvest. The animals must be processed on the spot and returned to the water. Some of these village laws have now been set as local by-laws, enforceable under national law (King & Faasili, 1999). These laws recognise the importance of the regenerative properties of the animal to the sustainability of the fishery. Without the inclusion of women's groups in the process of developing village fisheries management plans, their knowledge and concerns over this subsistence resource may not have been heard or included in the plans.

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