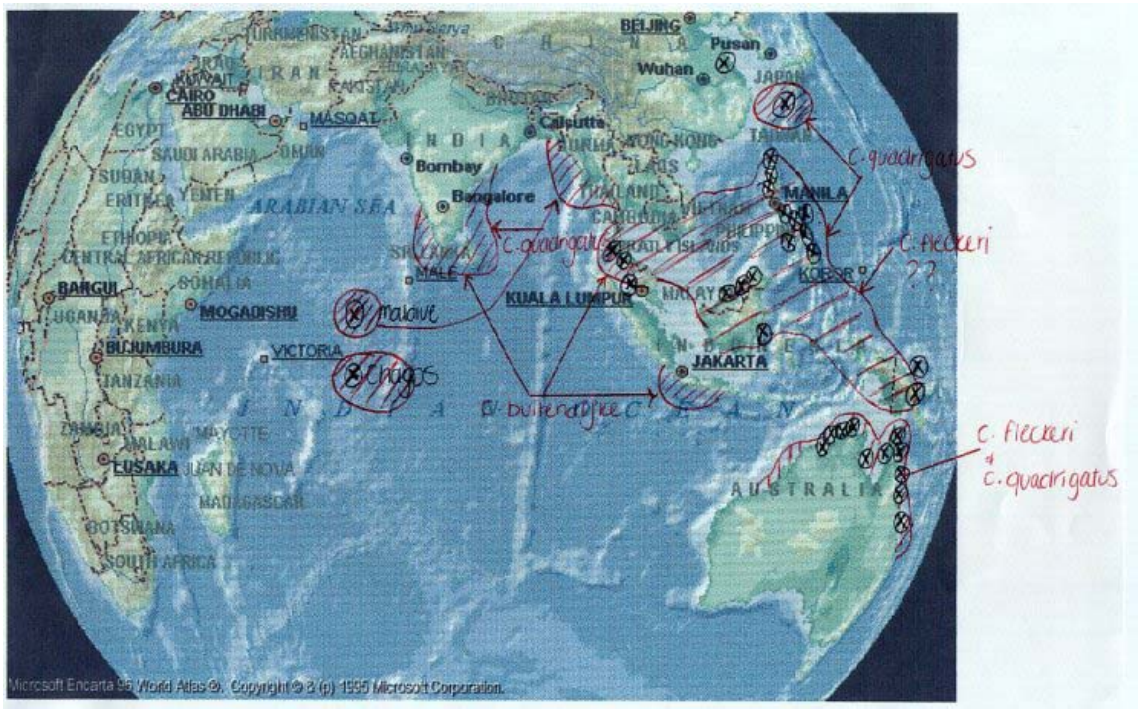
5.7 Rest of the world jellyfish – epidemiology of envenomation

5.7.1 The Eastern Pacific

Very little has been published on jellyfish stings in this area. The following information on jellyfish on the west coast of British Colombia down to California was sent to the author on Cnidaria e-mail (C. Mills 1997, personal communication).



Western coast of North America

The cold California current

The west California coast water is usually very cold all along the California coast, except some years in winter, when the usually-southward-flowing California current reverses briefly. Consequently there seems to be little problem with *Physalia*, but a much greater problem from large scyphomedusae like *Cyanea*.

Cyanea spp.

Apparently they are all *Cyanea capillata*, and known as the lion's mane. It is always a dark brick red colour (the *Cyanea* probably get their colour from algae – as with *Catostylus* on the Pacific west coast in Australia).

The *Cyanea* sting problem is very real in British Columbia and Alaska, where the tentacles routinely get caught in commercial (and sport) fishing gear. In SE Alaska, near Juneau, they are present in the fishing months from June to August and

probably persist at least until October. This is one of the reasons fishermen there deck themselves out in full rain gear, even when it isn't raining, as tentacles are continuously being flipped around the deck when the power block is pulling the nets in. The fishermen have tried various solutions to stop or reduce the pain of these stings, but have been unsuccessful (I do not know if they have tried ice in this freezing climate!). They seemingly wait for the pain to pass, which it does in 4-5 hours; no systemic symptoms have occurred that have been reported.

Gonionemus spp.

Gonionemus vertens is also in the north east Pacific around British Colombia. Although this small orange hydromedusan species produces very serious stings around Vladivostock (see 5.7.3), it doesn't sting at all in this region. Unpublished work (C Mills, 1997, personal communication) on local *Gonionemus* suggests that they are released from their hydroids late April through early June, and the medusae mature mostly by July, and last until early-mid August. Of interest, Mills states that she saw a preserved *G. oshoro,* from Japan that it looked “a little more delicate than ours” and that she has also seen two 9 x 11" photos of the Vladivostok one, sent by a Russian and “it looks pretty similar” (C Mills, 1997, personal communication).

Chrysaora spp.

Mills (C Mills 1997, personal communication) describes the *Chrysaora* taxonomy in the north east Pacific as “a mess.” She describes two species - *C. melanaster* and *C. fuscescens*, both originally described from Alaska (Brandt, 1835).

Chrysaora fuscescens

This species of *Chrysaora* is commonly found off California and Oregon and occasionally off Washington and British Colombia. Originally described from the central Gulf of Alaska it has been collected as far north as the Bering Sea and as far south as Mexico.

It often occurs in large aggregations close to shore in autumn and winter off central California and far offshore in the Gulf of Alaska. It is described as having “a very unpleasant sting.”

Chrysaora melanaster

This species is found in Japan, Kamchatka, Aleutian Islands, and is very common in the Bering Sea. The southern extent of *C. melanaster* is not certain. It has been

described as far south as California, although Mills (personal communication) feels it may have been incorrectly identified. They seem to be offshore species that occasionally come close to shore in great aggregations in late autumn.

Not too much is known about them and the names in the west coast literature are pretty confused. It is possible that *C. fuscenscens* and *C. melanaster* are colour variants of the same species (C Mills 1997, personal communication).

Chrysaora achylos

Recent investigations by Burnett suggest that a large (up to 450mm bell diameter) *Chrysaora* sp. has now been reported twice from California. It has been named *Chrysaora achylos* (Martin J W, Gershwin L, Burnett JW, Cargo DA, Blood DA. *Chrysaora achylos,* a new species of scyphozoan from the eastern Pacific – submitted for publication April 1997). Burnett assumes it is due to upwellings from deep waters off the Californian coast occurring approximately 30 years apart (J Burnett, 1997, personal communication).

Carybdea spp.

Recently, a cubozoan was reported in California (see 5.1.1), which occurs throughout the summer. However it does not appear to cause stings on unwary swimmers, although cases of stings may occur, but are not reported, a phenomenon that often seems to occur in Australia, where despite constant requests for information by the author, many stings go unreported.

Western coast of Central America

Very little is known about the jellyfish of this region, or their sting. Despite efforts during the time of this thesis, no positive information was available, apart from one case study: -

Sting in Costa Rica

Recently the author heard of a sting that occurred in Costa Rica (A Brycesson, 1997, personal communication).

Case history (courtesy Brycesson 1997)

About 1400 on 16 March 1997 a female tourist of unknown age was stung at a Manuel Antonia beach at Quepos, a town on the Pacific Coast of Costa Rica. She was swimming in about 1.5m of water, parallel to the shore where many small children were

playing in the shallow water. She suddenly felt searing pain “like being stung by a thousand bees” The pain “made her heart race” and “gasp for breath “. She made her way to shore where she rested on a log, still gasping for breath – a fact commented on by her husband. She had “linear lesions made up of lots of tiny little regularly-spaced blisters” which appeared over the next 10 minutes, which were surrounded by an area of erythema approximately 1cm. These lesions were “wavy” and present on both feet, both calves and the backs of her thighs, however, no tentacles were present on the skin.

As far as she is aware, there were no further stings that day, despite other swimmers also being present in the water. She had no further symptoms and that night went out to dinner, although she complained of tiredness. By the next day the tiny blisters were no longer visible and the marks resembles red welts. These rapidly disappeared leaving just a fine track of red dots.

Ten days later, after her return to England, the patient experienced severe local itching and the sting marks reappeared, settling slowly with cortisone-based creams.

Discussion

From the symptoms and the later delayed sensitivity reaction in the area of the stings, the author feels that it could only be a cubozoan, possibly a chirodropid? (cf. *Chironex* stings 5.6.1). Considering the rapid onset of both respiratory and cardiac symptoms, cardiotoxic and respiratory venom components are almost certainly present.

Although this sting may have come from the long trailing tentacles of the multi-tentacled *Physalia physalis*, these jellyfish, which are blown by the wind and do not swim, occur usually in large numbers, have an obvious, easily-visible float, are often beached and people are aware of their appearance. In chirodropids quite the opposite occurs. They are strong swimmers, rarely seen and most victims are totally unaware of their presence.

It is possible that *Physalia physalis* may cause severe, immediate pain, cause sting marks covering a wide area with blistering of the skin which may fade quickly - as in this case. With such immediate symptoms causing breathing difficulty and palpitations, the envenomation might well have been caused by a chirodropid envenomation. However, it would be unusual for the skin marks to fade so quickly.

Delayed hypersensitivity, as occurring in this case, is usually the result of chirodropid envenomation, although *Physalia* has also caused some unusual skin reactions (Burnett 1991). Serum from this lady has recently been obtained and sent to Burnett. It is hoped that serology may be able to identify the offending jellyfish (see 5.4).

5.7.2 The North Western Pacific - Far-east Asia

see Map 1 - the Indian and West Pacific Oceans – human deaths and chirodropid distribution.

China (east)

Stomolophus nomurai

Stomolophus nomurai is found in the temperate waters of the north west Pacific in Japan, Korea and northern China. In China it is present in the North China Sea (the Yellow Sea and Bohai) and the East China Sea. It is a seasonal jellyfish, appearing first in the warmer waters in the south, moving northwards from June to November. It is most common in August and September (Mingliang, in Williamson *et al* 1996, p214) where it is often found in shallow water, particularly during or after rain. It causes severe stings to swimmers and fishermen, and has now been responsible for at least eight deaths in the China seas (Mingliang 1988b, 1992; Mingliang & Qin Shede 1990, 1991). The fishermen are actually `jellyfishermen' trawling and netting for the jellyfish which, after curing, are eaten as an hors d'oeuvre in Japan and China (Mingliang 1988a).

Appearance

The bell is translucent or milky white in colour, dome-shaped and up to a metre in diameter. The outer surface (exumbrella) is covered with many sand-like dots on its outer surface. Numerous tentacles up to a metre in length hang beneath (Mingliang, in Williamson *et al* 1996, p.215). This is in contrast to the specimens described in Kramp (1961, p.382) which are simply mentioned as variants of *S. meleagris* - just 180mm bell diameter.

The author believes that this jellyfish also needs studying as it may be another, unknown, or incorrectly-named species.

The sting

Multiple whip-like lesions occur, and are usually present on the arms and legs of swimmers. Mingliang (in Williamson *et al* 1996, p.215) states that Chinese

fishermen who have often been stung by the jellyfish usually show only mild reactions. This is comparable with Australian fishermen who often feel that have acquired a `resistance' to chirodropid stings sustained from fishing net catches. As it seems unlikely that a resistance can be acquired to a venom causing direct skin damage, the author feels that this may be due to keratinisation of the skin from exposure to the sun and salt water during the fishing season (Fenner, in Williamson *et al* 1996, p.215).

Symptoms and signs

Although the majority of stings have no severe systemic symptoms, victims with large stings may develop severe muscle pain after one to four hours. This may be accompanied by fever (38--39^{o}C), nausea, vomiting, profuse sweating, anxiety, central cyanosis and even occasional breathing difficulty {cf. Irukandji syndrome above) (Mingliang, in Williamson *et al* 1996, p.215). Some victims may develop a sinus tachycardia, haemolysis of red blood cells and acute renal failure.

Human deaths

Deaths occur from acute pulmonary oedema one to four hours after the sting. In the summers of 1984, 1986, 1987 and 1988 about 3000 people were stung in Beidaihe beaches (a city on the coast of Bohai in China) by *Stomolophus nomurai*. Eight deaths occurred from acute pulmonary oedema and cardiac arrest (Mingliang 1988b; 1992).

Further Research

Professor Qin Shide and Dr Zhang Mingliang have published extensively on the *Stomolophus* nomurai, and supplied all the information above (Mingliang 1987; 1988; 1992; Mingliang & Qin Shede 1990; 1991; 1992).

USSR

Gonionemus

(Y Yakovlev, 1994, personal communication)

Distribution and appearance

Gonionemus vertens is a tiny hydroid, which is widely distributed in the Northern Hemisphere. However, in an area around Vladivostock, previously in the USSR, it causes a severe envenomation syndrome at certain times of the year

Symptoms

The envenomation syndrome induced by *G. vertens* in humans develops in a similar manner, and with some symptoms similar to the Irukandji syndrome (see above). However, some victims have even more bizarre symptoms with neurological and "psychiatric" symptoms also occurring (Yakovlev & Vaskovsky 1993).

Vladivostok

Dr Yuri M Yakovlev and colleagues of the Institute of Marine Biology, Far East Branch, Academy of Sciences, Russia, are continuing their pioneering observations on the fascinating *Gonionemus vertens*, with its syndrome similar to that of the Irukandji, and have a manuscript published in Russian (Yakovlev & Yakovlev 1993). Dr Yakovlev supplied all the information on *Gonionemus* in Vladivostock (above).

Japan

Gonionemus oshoro

Distribution

Around Niigata, an area on the north-west coast of Honshu northwards to Hokkaido in Japan (Otsuru *et al* 1974) - the eastern shore of the Sea of Japan. This is directly opposite the coastline of eastern Russia and Vladivostok, and the proximity of the Japanese and Russian locations for *Gonionemus* raises the additional possibility that these may be the same species in the Sea of Japan---see *Gonionemus vertens* above.

The sting

Gonionemus oshoro causes numerous stings in swimmers on Honshu. It occurs in the eastern side of the Sea of Japan amongst seaweed that is harvested by female swimmers. It causes an Irukandji-like syndrome (see above) with apparent temporary psychiatric symptoms. (Pigulevsky and Michalev 1969; Otsuru *et al* 1974). Interestingly, the same symptoms can occur from eating the seaweed that the swimmers harvest, presumably due to *Gonionemus* being present as a contaminant.

Physalia spp.

Multi-tentacled *Physalia* cause stings on the eastern coast of Honshu in the late summer (Japan Surf Life Saving 1992 unpublished data) but detailed information is not available.

Tamoya spp.

Tamoya haplonema, bursaria and *virulenta* have been recorded from Japan (Kramp 1961). However there are no details of any problems stings in Japan, even though the same, or similar species cause envenomation problems in Australia.

Okinawa

Chiropsalmus quadrigatus has been identified in Okinawa by Shokita (1986). However, the author feels this identification is now in doubt. One death and two near-deaths have now been confirmed (Table 3), and hundreds of minor stings occur each year (Y Araki, 1995, personal communication).

Kohama (1995), Tomihara, Araki and his colleague Cheryl Lewis from Okinawa, Japan are providing valuable information concerning jellyfish in that region. Cheryl Lewis kindly supplied some of the information on *Chiropsalmus quadrigatus* in Okinawa.

Appearance

Based on 217 specimens collected from 1978-96 by Y Araki, from 5 different areas of the Ryuku Islands (Okinawa is one of the Ryuku Islands).

Based on bell height rather than bell diameter : -

- smallest was 2.40 mm with 1 tentacle per pedalium
- largest 117 mm in bell height with 7 tentacles per pedalium
- most of the specimens had 7 tentacles per pedalium, a few had 8 and one specimen had 9 - it was about 84 mm in height.
- The average of the specimens with 7 tentacles per pedalium was 60.9 mm but the range was 28.7 - 116.7 mm in height)
- Gonads are similar to Chironex, measurements were made of the lengths of the `gastric saccules', but density ratios have not yet been determined.

(C Lewis, 1996, personal communication).

5.7.3 West Pacific

see Map 1 – the Indian and West Pacific Oceans – human deaths and chirodropid distribution.

Papua New Guinea, East Thailand, Malaysia, Indonesia, Philippines

The presence of multi-tentacled box jellyfish species (chirodropids) has now been confirmed in the tropical Indo-Pacific oceans westwards to the Maldive Islands including Brunei, the Philippines and southern Japan, Sarawak, Sabbah, Papua New Guinea, Malaysian archipelago, Gulf of Thailand, Java and Southern India. (Fenner & Williamson 1996).

Deaths had previously been reported from Penang, Malaysia; the Philippines; Bougainville Island, Solomon Islands; `North Borneo' (now Sarawak, Brunei, Sabah); d'Entrecasteaux Islands and (Papua) New Guinea (Cleland & Southcott 1965, p114-116). Further deaths and case histories first recorded by Fenner & Williamson (1996) from cases in the database collected during this thesis are also recorded here: -

Brunei / Sabah / Labuan Island

Deaths and severe stings from jellyfish have occurred in Brunei and Sabah (J Hooper, 1992, personal communication):-

Fatal stings

1. Penanjong Beach 7 July 1989 - a seven-years-old English girl died after a jellyfish sting in thigh-deep water. Resuscitation on the beach was ineffective and the moribund child was taken on a 10 minute drive to hospital where she later died. The cause of death was stated to be `heart failure'.
2. On the north coast of Labuan Island at Tanjung Kubong, 2 July 1992, a 10 year-old boy was stung whilst swimming with his father. He was taken to hospital within 30 minutes of envenomation, but died 4 hours later.

Details concerning the medical management of these two stings are not available. Four other deaths suspected in this region cannot yet be confirmed (Nor Azila, 1992, personal communication): -

- In 1983 a 14 year-old British girl on Tutong Beach, Brunei;
- In 1989 a Malay man on Tutong Beach;
- In 1990 a Malay man in Miri (Sarawak);
- In 1991 a Malay man whilst fishing off `a beach'

Medical Officers working at the Labuan District Hospital have been quoted as saying that there are 2-3 deaths per year from jellyfish stings (Nor Azila, 1993, personal communication). In addition, every year another 1 or 2 victims that survive are brought in unconscious, intubated and given intra-muscular (IM) chlorpheniramine and adrenalin. They commonly remain unconscious for some 12-24 hours.

Case history

Described by Dr J Hooper (1992, personal communication) – recorded by Fenner (Fenner & Williamson 1996)

At 0800 on 1 June 1992 on an overcast morning on Labuan Island, the day after high winds, a four-years-old boy stepped off a floating log into 2 feet deep clear, calm water on to a sandy bottom. As he walked to shore he stopped and began to scream. He was pulled from the water and adherent tentacles were seen on his legs; vinegar was poured all over the stung area whereupon he promptly stopped breathing. He was given a few breaths of expired air resuscitation (EAR) and resumed spontaneous breathing; he again stopped breathing and became cyanotic with dilated pupils. As his pulse could not be felt he was given a couple of external cardiac compressions and a further few breaths of EAR. He again started to breathe, and again his pupils constricted and his carotid pulse became palpable.

Over the ensuing 40 minutes, during a speed boat trip to Brunei, he was in "agonising pain" and his limbs had to be restrained. He started to breathe shallowly but responded to commands to "take deep breaths". On arrival at the hospital he was conscious, but drowsy; tachypnoeic with nasal flaring and mild cyanosis; crepitations could be heard bilaterally, and linear erythematous, whiplash-like wheals were extensive on both upper and lower limbs and the skin of the anterior abdomen. His blood pressure was 110/70 mm Hg and his heart rate was 120/min. Intra- nasal oxygen was administered.

An hour and a half later his condition had deteriorated. He was becoming more cyanosed and dyspnoeic and coarse crepitations were audible bilaterally on auscultation. A chest X ray confirmed acute pulmonary oedema with generalised opacifications in both lung fields. He was transferred to an intensive care unit, intubated and intermittent positive pressure ventilation (IPPV) was commenced with an FIO_2 of 0.60, intermittent mandatory ventilation (IMV) of 30 /min, and positive end expiratory pressure (PEEP) of 5cm H_2O. His Hb saturation increased from 85% to 95%. His blood pressure fluctuated from 110-125mm Hg systolic and 60-80mm Hg diastolic, his heart rate from 100-160 beats per minute. A 2D-echo-cardiographic examination showed good cardiac contractility.

Towards the end of day 1 fundoscopy showed bilateral papilloedema. Fluid restriction, together with intra-venous (IV) mannitol 10%, 75ml six hourly, IV frusemide 4mg/6 hourly and IV dexamethasone 2mg/6 hourly were commenced. The patient's general condition improved over the next 24 hours and on day 2 chest X ray showed almost complete

resolution of the pulmonary oedema. Two weeks later severe itching occurred around the healing wounds which responded slowly to topical steroid cream. Scars were still present over a year later.

Five other cases were also reported from this area (Fenner & Williamson 1996).

Table 17 - Fatal and serious chirodropid stings in Malaysia

Case	Location	When	Victim	Details
Fatal stings				
1	Penanjong Beach	July 1989	Girl, 7	Resuscitation on the beach ineffective; died later in hospital.*
2	North Labuan Island	July 1992	Boy, 10	Taken to hospital within 30 min of envenomation, but died 4h later.'
Serious non-fatal stings				
3	Labuan	June 1992	Boy, 4	Stopped breathing with application of vinegar. Resuscitation required for intermittent respiratory arrest. Severe pulmonary oedema and papilloedema diagnosed on admission to hospital, Extubated Day 2, discharged Day 5. full recovery with scarring.*
4	Northern Labuan	March 1991	Boy, 11	Remained "unconscious" for 24 h before recovering.
5	Northern Labuan	May 1991	Girl. 10	Collapsed during removal of tentacles and was bandaged before they were all removed. Developed a "lock-jaw" within 30 min of envenomation. Intubated for respiratory arrest and remained unconscious for 12 hr
6	Labuan	July 1991	Boy, 3	Less than 0.5 m tentacle contact. Promptly "arrested" but was successfully "resuscitated".
7	Brunei	June 1992	Woman,	Stung on 70% of one leg; respiratory arrest on the beach but was successfully resuscitated. Stopped breathing with application of vinegar. Received one ampoule of Commonwealth Serum Laboratories (CSL) *Chironex fleckeri* antivenom in hospital.
8	Pulau Sapi,	December 1992	Boy, 3	Collapsed within 30s of the sting. Sabah Received cardiopulmonary resuscitation (CPR) and recovered within 24 h in hospital.

Discussion of cases above

Applying vinegar

Vinegar was recommended as a first-aid treatment for *Chironex fleckeri* nematocyst inhibition in Australia by Hartwick *et al* (1980). Household vinegar has been a traditional treatment for box jellyfish stings in the Philippines since the turn of the century, although other "traditional" treatments were also used (see above). Fishermen in Kukup also describe the use of vinegar as the treatment of stings from a cubozoan jellyfish in Malaysia (see above).

In case 3 and 7 in Table 17, victims were said to have stopped breathing whilst the vinegar was poured on the stung area. It is not known if this was caused by the vinegar or whether it was about to happen anyway. The co-incidence is high for reports of sting treatment in this area, and has not been reported from any other area of the world prior to this. Further research is necessary to discover cause and effect.

Removing adherent tentacles

In case 5 in the above Table 17, the victim lost consciousness whilst adherent tentacles were removed. Previous advice has been for rescuers to pick off adherent tentacles from the area if vinegar is unavailable, and before applying any compression bandages (Fenner *et al* 1989). A single report will not alter this advice but further studies are needed.

Papilloedema

In case 3 papilloedema was observed. This was the first occasion this had been described (Fenner & Williamson 1996) in a chirodropid. It has also now been described in the carybdeid *Carukia barnesi* (the Irukandji)(Fenner & Heazlewood 1997).

<u>Malaysia</u>

Associate Professor Nor Azila PhD and Associate Professor Iekhsan Othman, MD, of Universiti Malaya, Kuala Lumpur continue their work on the biochemical effects of jellyfish venoms, as well as keeping us up to date on deaths and other severe stings in the area (see above). First hand contributions from Major (Dr) RWH Hooper of Brunei assisted in the collation of deaths and serious stings in Labuan, and Brunei (see above).

Severe stings continue to occur in Batu Ferringhi (Burnett *et al* 1994). Neurological complications of stings from the Penang region have been previously documented (Williamson *et al* 1988; Peel & Kander 1990).

Indonesia – Kalimatan : -

Fatality

Recently on Cnidaria-net, a previously-unreported death was reported of a 7-year-old boy (nationality unknown) at Balikpapan – on the mid-east coast of Indonesia. The report states the boy was jumping off a pier at Balikpapan beach. He got out of the water immediately, collapsed and died within 4 minutes. He was noted to be covered in whip-like marks over half of his body.

The rapid death, the characteristic markings and the almost-certain presence of chirodropids all through this region, as suggested by this thesis, suggest that this death has to be caused by a chirodropid.

Seemingly people have been swimming at this beach for many years (up to 10) with no previous account of stings. The locals are said to have remarked that nobody swims in the sea after rains, or when the water is cloudy (see section on *Chironex* above), Most locals cannot swim and so do not usually get into the sea (R Grenfell, 1996, personal communication).

Thailand

In 1987, Dr John Williamson accompanied Dr Bob Hartwick on a trip, visiting Thailand. Although they caught no jellyfish (it was getting late in the `season'), they discovered a Dermatology clinic at Siriraj Hospital, Bangkok, where, each week, many cases were seen with severe skin lesions caused by jellyfish stings. The lesions were necrotic, ulcerated and scarred - all characteristic of chirodropid envenomation. Burnett also reports severe scarring after a cubozoan sting (Raupp *et al* 1996). A later visit to Thailand (the east coast only) in 1990 by the author also failed to find chirodropids.

Human fatalities

In December 1995, two human deaths were described after jellyfish envenomation at Langkawi Island, on the west coast of Malaysia on its border with Thailand (Fenner & Williamson 1996). The victims' rapid demise and the characteristic skin markings

suggested that the causative jellyfish was a chirodropid. In this area most likely species is either *Chiropsoides buitendijki*, or possibly *Chiropsalmus quadrigatus.*

There have been reports on a series of jellyfish stinging in Thailand divers that were followed some days later by temporary loss of voice (A Rhodes, 1994, personal communication). It is suspected, but not confirmed, that the offending jellyfish may have been large carybdeids? He also advises that marine stingings continue to occur in the Thai region and that he has photographed a chirodropids underwater, at night, in the Andaman Sea (Rhodes, in Williamson *et al* 1996, p294).

Studies concerning the effects of treatment of stings with a Thai plant extract suggest they may offer relief from pain and increased healing. Further studies are under way (Pongprayoon *et al* 1991).

5.7.4 The Bay of Bengal (Eastern Indian Ocean)

Apart from that in 5.1.1 and 5.1.2 above, no further information is available from this area

5.7.5 Western Indian Ocean and The Arabian Sea

see Map 1 – the Indian and West Pacific Oceans – human deaths and chirodropid distribution

Maldives, Chagos, Oman, West Indian Coast, Eastern Africa

Sanderia malayensis

Distribution

Sanderia malayensis has been reported from East Africa, the Suez Canal, the Red Sea, the Arabian Gulf and Oman and through to India. It has been reported as far afield as Malaysia, the Philippines and even Japan, although not Indonesia, Papua New Guinea or Australia. There is a suspicion that the animal may be a cause of unidentified envenomations over a wider Indo-Pacific region than has been appreciated (Cornelius & Burnett, in Williamson *et al* 1996, p231).

Appearance

The bell is colourless to yellow with reddish spots. It is flat-topped, and 30--80 mm in diameter, although rarely up to 130 mm. The edge of the bell is vertical and

leads to a `skirt' from which up to sixteen marginal tentacles hang. The four gonads, located in the bell, vary from clear to brown or purple.

The sting

Stings may be severe, causing local skin necrosis. It is possible that this species may be the cause of the peripheral vasospasm and tissue necrosis reported in two papers (Abu-Nema *et al* 1988; Williamson *et al* 1988). Many severe stings occur in this region, which are rarely identified, do not seem like chirodropid stings, and may be due to this species. It must be considered in all severe stings from this region.

For treatment, see Section 5.8.4.

Pakistan

Dr Junaid M Alam, University of Karachi has completed his PhD thesis, providing valuable information of jellyfish stings in and around Karachi.

Physalia spp.

(J Alam, 1995, personal communication).

Sting data

Twenty nine severe stings occurred, caused by both *Physalia utriculus* (single-tentacled) and *P. physalis* (multi-tentacled);

- Patient ages ranged from 8 years to 35 years;
- Half of the patients were male, half female;
- Tentacles were usually adherent;
- Most stings occurred in the late afternoon (author – possibly when most people swam?);
- More than one person stung at the one time was common;
- As well as the immediate-burning pain, "muscle cramps and spasms" (worst in the sting region) were common, lasting some 1-2 hours;
- 9 patients had transient leg weakness or "ataxia";
- 6 patients had sweating and nausea;
- 3 patients developed bradycardia, which resolved spontaneously.
- a popular but uncontrolled local Karachi treatment is the application of sliced onion to the fresh sting area.

Indian Ocean

Diego Garcia, Chagos Archipelago

The Chagos Archipelago is a group of small islands constituting the British Indian Ocean Territory in the central Indian Ocean. In the 1970s Diego Garcia, an atoll at the southern end of the group, became the site of a United States communications center and naval base. The islands have no permanent civilian inhabitants and have been organized as the British Indian Ocean Territory since 1965. Little is known about the environment, and if mangroves are present, but a man aged 39 years was stung in May 1991 - few details are available, although CSL *Chironex* antivenom was used with seemingly excellent effects. It is postulated that the offending animal here may have been *Chiropsalmus quadrigatus*. Attempts to obtain this patient's serum and to obtain further details have failed.

La Réunion

A brief description of observations in La Reunion island in the Mascarene Archipelago in the south west Indian Ocean was obtained (N Gravier-Bonnet, 1995, personal communication). Divers occasionally saw single cubomedusae (?large carybdeids). They caught a specimen floating at the surface of the ocean. It was 14 cm high (from the top of the bell to the tip of the remaining contracted and incomplete tentacle), and about 3mm thick at the proximal end of the tentacle. Bell width was 7 cm. It was described as a large carybdeid, but no further identification is available (N Gravier-Bonnet, 1995, personal communication).

It seems La Réunion gets many *Physalia* stings - during the week-end up to 150 people may receive stings. Fortunately the *Physalia* are only small specimens and no systemic symptoms have been recorded.

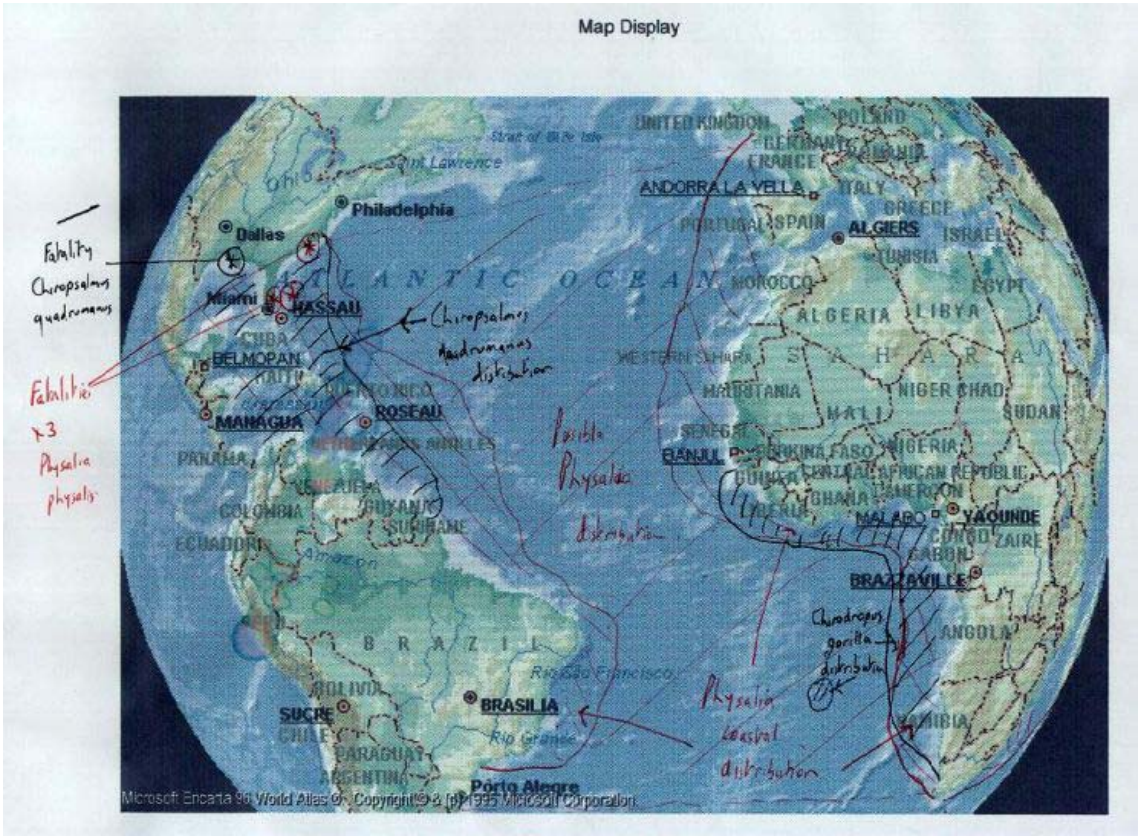
Gulf of Oman

Dr Pratap Chand, MRCP, DM, Associate Professor of Neurology and his biologist colleague, Professor Reginald Victor, PhD, at the Sultan Qaboos University in Muscat, Sultanate of Oman, have commenced a formal survey of marine envenomations in the Gulf of Oman. The results of their work received preliminary publication in their Chapter in Venomous Plants and Animals (Williamson *et al* 1996, p.404-410). Other data will be published in the future.

Other jellyfish

Very little is known about jellyfish in this area, despite extensive investigation by the author during, and prior, to the period of this thesis. However, chirodropids and carybdeids have certainly been reported in the region (Haeckel 1880; Mayer 1910; Kramp 1961), as well as the ubiquitous *Physalia* spp., which are present in all temperate and tropical oceans, and are know to cause medically significant stings.

A reply E-mail to a request for help suggested that there were very few stings on the Zanzibar coast (M Richmond, 1996, personal communication). He has snorkelled extensively in the area and has only seen *Aurelia* and *Mastigia*, nether of which cause problem stings. He had heard of large numbers of *Pelagia noctiluca* that were present on one occasion (not stated) which caused a number of stings, none of which were serious.



5.7.6 South East Atlantic

see Map 2 above - the Atlantic Ocean – human deaths and chirodropid distribution

West Africa

Chirodropus gorilla

To the knowledge of the author there have been no published accounts of serious stings or deaths. However, *Chirodropus* sp. is encountered in geographical areas (including the West Coast of Africa) from where there have been few reports of marine envenomation. It may be that they are deep-water jellyfish and rarely enter shallow waters where stings occur. *Chirodropus gorilla* has been confirmed off the west African coast and in the Benguela Current as far south as South Africa (Pagès *et al* 1992; Fenner, in Williamson *et al* 1996 p262). Its morphology is currently under investigation by the author (see above).

First aid and medical treatment

The treatment for all chirodropids studied to date is similar, and would probably follow general guidelines listed for cubozoan envenomation in 5.8.3 and 5.8.4.

South Africa

Physalia spp.

Correspondence with Professor Charles Griffiths of the Zoology Department of the University of Capetown, Dr Bromfield of the City of Capetown Health Department and Dr Phil Heemstra, Curator of Marine Fishes at the JLB Smith Institute of Ichthyology in Grahamstown has given an idea of the problem in South Africa from Physalia stings.

A report from the three main beach areas of the City of East London, South Africa, confirmed "extremely plentiful" *Physalia* during summer months, pushed ashore by north-easterly onshore winds. Records of *Physalia* stings from the region were:

1987	202 stings
1988	371 stings
1989	456 stings
1990	170 stings
1991 (to June)	91 stings.

Among these stings were some hospital admissions due to "allergic reactions - in most cases the glands in the throat were swollen, causing constricted air flow and difficult breathing." Photographs from South Africa confirm the presence of the single-tentacled *P. utriculus* and the multi-tentacled *P. physalis*.

5.7.7 South West Atlantic

see Map 2 – the Atlantic Ocean – human deaths and chirodropid distribution.

Physalia physalis

The large Atlantic species, caused a recent mass stinging of 295 persons in Sâo Paulo in January 1994 (250 in Guarujá, 30 in Praia Grande, 15 in Santos). Many people required medical attention, and two children developed respiratory arrest, responding to resuscitation (translation taken from the Argentine newspaper `*Diario La Capital*', Thursday 20 January 1994) (Mianzan, 1996, personal communication).

Usually, however, there does not appear to be a great problem with *Physalia* stings in the south western Atlantic (Mianzan, 1995, personal communication). The main problem jellyfish on the coast is *Olindias* (Mianzan, in Williamson *et al* 1996, p.206)

Olindias sambaquiensis

(courtesy - Mianzan, in Williamson *et al* 1996, p.206-208)

Distribution

The animal occurs in South American sub tropical and temperate coastal waters, being common along the south-west Atlantic Coasts of South America in Brazil, Uruguay and Argentina.

The species is common during spring and summer in Uruguay, Argentina and southern Brazil where it swarms annually in Argentina during January and February. It is also present in northern Brazil in the winter

Appearance

The bell is transparent and flat, usually up to 10-cm diameter, although larger has been described. Ripe gonads are yellowish and easily seen through the umbrella. Each medusa has about 380 tentacles of two types: short, reddish brown primary tentacles and with secondary thin yellow/pink tentacles up to 50 cm long.

The sting

Stings are common on the back and extremities of human victims. Instant burning skin pain occurs which may persist for several hours. The tentacle marks have a typical appearance of red zigzag lines, or irregular white welts with a red surrounding with marks persisting for up to a week.

Some 500--1000 bathers are stung along the whole coastal area around Buenos Aires, and many others are probably not recorded.

First aid and medical management

In Argentina adherent tentacles are washed off with seawater and 20% ammonia in water is applied to reduce the initial pain, although giving little, if any, relief. IM dexamethasone appears to be effective for victims who develop systemic symptoms such as dyspnoea or fever.

Argentina

Dr Hermes Mianzan, PhD, and Dr Fernando Ramirez, PhD, of the Instituto Nacional de Investigaciones y Desarrollo Pesquero (INIDEP), in Mar del Plata, have researched the occurrence of *Olindias sambaquiensis* and *Physalia* in the region (see above), and published widely (Mianzan *et al* 1988; Mianzan & Zamponi 1988; Mianzan 1989; Kokelj *et al* 1993b; Mianzan & Ramirez 1994).

Brazil

Recently Morandini & Marques (1997, personal communication) have found three cubozoans in Brazil: *Tamoya haplonema*, occurring from São Paulo to Santa Catarina State; *Chiropsalmus quadrumanus*, from Pernambuco to Santa Catarina State; and *Tripedalia cystophora*, recorded for the first time in Brazil, Pará State (Salinópolis mangrove, near the mouth of the Amazon River (A Morandini & A Marques, 1997, unpublished data). On the Brazilian coast, even with this wide distribution along the Brazilian coast, and sometimes with large numbers of *Chiropsalmus quadrumanus* in the southern Bahia State (their unpublished data), there have been no reports of envenomation caused by cubozoans in Brazil until recently.

Case report

(Morandini A C & Marques A C 1997 "Morbakka" syndrome: first report of envenomation by Cubozoa [Cnidaria] in Brazil. Unpublished article).

On July 15, 1995, while swimming with others in shallow water (1.5 m depth) at Cabelo Gordo de Dentro beach, São Sebastião channel, São Paulo State, a 23-year-old healthy male was stung in his right arm by a large specimen (15 cm high, 7 cm wide, contracted tentacles 20 cm long) of *Tamoya haplonema* (identified later in their laboratory.

> The sting was felt as sequenced pin-pricks and burning. The region was immediately washed with vinegar. The pain settled rapidly and no systemic symptoms were experienced. The skin marks disappeared within the next few days and no scarring occurred.
> The nematocysts of the tentacles of another specimen of *T. haplonema* were identified as microbasic mastigophores, the same as those found by Fenner *et al* (1985) in the skin of their victim.

Two other cubozoans were also found in Brazil by these authors: -

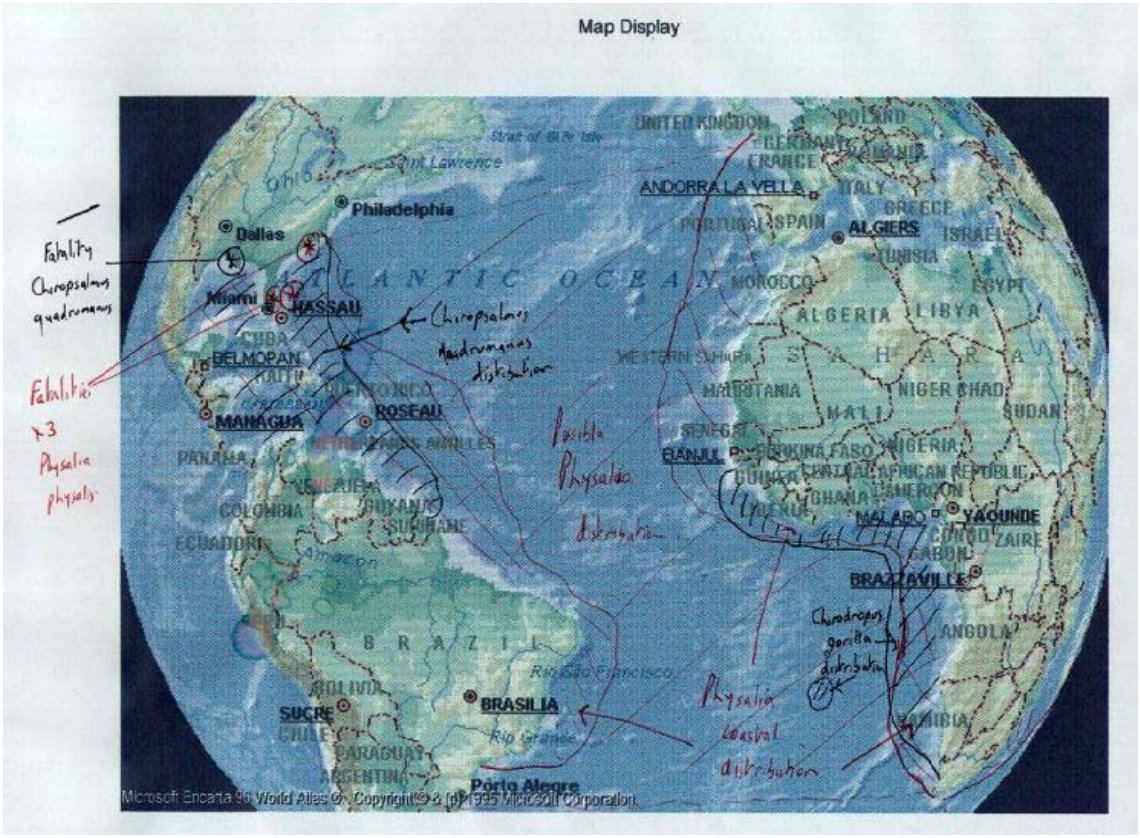
"Tripedalia cystophora is a small medusa (up to 1 cm in height) with short tentacles; it has not been recorded as causing human envenomation.

Chiropsalmus quadrumanus, is bigger (around 6.5 cm in height), and has caused a death in Texas (United States) (Bengston *et al* 1991). One of us (ACM) was lightly stung by *C. quadrumanus* in Bahia State (Brazil). A localised burning pain was followed by itching, but there were no further systemic effects (unpublished data)."

Cnidarians stings are probably underestimated in Brazilian waters. General precautions must be followed where these animals were recorded, including the São Sebastião region, particularly during the winter season, when *Tamoya haplonema* reaches the shallow coastal waters. After an accident, in view of the potential lethal effects of some stings, rapid identification of the offending jellyfish may be critical (Fenner 1991).

5.7.8 North West Atlantic

see Map 2 – the Atlantic Ocean – human deaths and chirodropid distribution.



Chiropsalmus quadrumanus

Distribution

The chirodropid *Chiropsalmus quadrumanus* has been described in waters along the eastern coast of the Americas between the tropics, including many Caribbean islands (Kramp 1961). Serious stings from *Chiropsalmus quadrumanus* have also been reported from beaches in Puerto Rico during the summer months (B Cutress, 1992, personal communication).

The sting

Very similar in effects to all described chirodropids. However, envenomations are rare, as they are a nocturnal species, usually appearing only at night. Very little is know about stings in the USA (except for the fatal case, below), although, as stated, they seem to be a problem morbidity-wise in the Caribbean.

Fatality

A fatal chirodropid envenomation occurred on 20 June 1990 in a 4-year-old boy at Galveston Island in the Gulf of Mexico, after envenomation with 1.63m of tentacle contact on his left arm. He died within 20 minutes from what was reported as cardiac arrhythmia and pulmonary oedema, despite cardiopulmonary resuscitation by para-medics. Remaining nematocysts (stinging cells) on the envenomated skin were identified as being from the chirodropid *Chiropsalmus quadrumanus*,

previously described in that region. Mader, in Galveston (M Mader, 1996, personal communication), also believed a second human fatality has occurred.

Physalia physalis

Distribution

Multi-tentacled specimens of *P. physalis* are distributed world-wide in the temperate oceans (ie. all except the Antarctic or Artic Oceans). However, in the north Atlantic they reach their greatest size, and cause the worst systemic symptoms. They have been responsible for a least 3 deaths of previously-health adults, in Florida in the south eastern part of the United States (Burnett & Gable 1989; Stein *et al* 1989). They have also caused severe, sometimes life-threatening stings on both sides of the north Atlantic (Russel 1966; Burnett *et al* 1994).

The sting

(Fenner, in Williamson *et al* 1996, p 196)

Instant severe pain, often with some tentacle remaining on the skin. A characteristic sting is produced where the beads visible on the tentacle caused visible raised white beads on the skin. This white beading is linear and joined by red lines with an erythematous flare. Local piloerection and local sweating is invariably present

In larger stings systemic symptoms include nausea, vomiting, tender lymphadenopathy, syncope, convulsions and muscular cramps (Halstead 1988; Burnett *et al* 1994).* Respiratory acidosis from hypopnoea has occurred, possibly due to chest pain (Kizer & Piel 1982).

Case study

(From Burnett, Fenner *et* al 1994)

A healthy 45 year old scuba instructor had just surfaced from a thirty foot depth at Pacific Reef off Miami, Florida on December 19. 1987. As his head broke the surface and he was handing a lobster from each hand to a boat captain he felt a slight sting, almost like a mosquito bite on his left cheek. At that time, he suddenly felt a series of vicious burning sensations on either side of his face and neck, and everywhere that he was not protected by his mask, regulator or wet suit.

He had surfaced directly under a large Man-o'-war, which was then sitting on his head, with the bulk of its stinging tentacles wrapped around his neck and head. The immediate response was to grab its body and attempt to remove it from his head, throwing much of it down current. He dropped out of his buoyancy vest, which was then secured by the captain,

and exited the water onto the dive platform, where his skin was doused with approximately 1 quart of ammonia solution. The pain was intense and seemed to get stronger.

He experienced excruciating pain along the mid-line of his chest, sacral area and right deltoid which did not radiate. Within 5 minutes he experienced strong tonic/clonic spasms of all skeletal muscles, severe spasms in the abdomen, and a decreasing ability to concentrate or breathe adequately. He began to administer oxygen at 61 per minute via simple mask, but did not feel adequately ventilated, and switched to a nasal cannula at the same flow.

The process of breathing became exhausting and was confined to the apices because of abdominal spasms. He assumed a semi-fowler position as the rescue boat approached shore. Since his veins were difficult to locate, intravenous fluid therapy was postponed until arrival at the hospital. The patient was unconscious during a helicopter ride inland from the boat dock and during the transfer from the hospital rooftop to the emergency room, a period of at least ten minutes. At that time intravenous therapy was started, Ringers solution administered and foley catheter installed since tachycardia with frequent premature ventricular beat appeared on his electro cardiograph. Arterial blood cases at hospital arrival (on 60% O2) revealed a pH 7.8, pCO2 11 and PpO2 100.

The patient was discharged after seven to eight hours of observation having received four litres of fluids. He was placed on an oral analgesic (oxycodone 5mg/acetaminophen 325mg) and hydrocortisone.

Two days later the patient had violaceous urticarial lesions on the hands, face and neck. The latter two areas were still oedematous and by then pruritic. Generalised fatigue persisted for at least ten days and local hyperpigmentation for many weeks. Slight oedema and hypothesia of the left face was present for at least three weeks. Serological examination of the patients serum five years after this episode revealed positive test at a dilution of 1.450 (normal 1.50 or less)(Burnett *et al* 1988).

Halstead (1988) also described a diver in the Caribbean Sea off Isla de Providencia (east of Nicaragua) who surfaced under an Atlantic *Physalia* spp. He almost died overnight, suffering excruciating acute pain with an extensive vesicular-necrotic shoulder lesion. There was a suspicion of tetanus developing later, but the full outcome of the case is unknown; recovery was thought to have occurred. Burnett & Gable (1989) also described a fatal Atlantic *Physalia* sting in similar circumstances involving a scuba divers.

Immunological problems with Physalia

A number of unusual immunological problems have been seen with *Physalia: -*

1. Recurrent eruptions following single envenomations have been reported (Burnett & Calton 1987b).
2. a distant reaction in the mouth was noted in one patient who was stung only on her feet (Matusow 1980).

Other unusual problems with Physalia

Serious envenomation from an Indian Ocean (Goa) jellyfish was reported, in which a *Physalia* sp. was suspected on the basis of serological titres (Burnett *et al* 1988), of producing localised necrosis, vasospasm and gangrene (Williamson *et al* 1988). However, the identity of the jellyfish was not confirmed and may even have been *Sanderia malayensis* (see above).

Mononeuritis multiplex has been reported in a patient envenomated off the American mid-Atlantic coast (Filling-Katz 1984).

Reactive arthralgia of significant duration can follow the sting (Weinberg 1988).

Acute renal failure and gross haematuria have been reported (Spelman *et al* 1982, Guess *et al* 1982).

Acute skin necrosis of the fingers occurred after *Physalia* envenomation in Brazil in 1995. It needed surgical debridement and resulted in significant loss of finger function (Carlos de Frietas *et al* 1995).

There is a single report of the development of `hallucinatory fits' for 3 days after a mild *Physalia* sting to the foot on a sailing ship in the Azores (Fenner in Williamson *et al* 1996, p298). There was no previous personal history of mental abnormality. Cause and effect could not be established.

Linuche unguiculata

Distribution

Linuche unguiculata occurs in the tropical Atlantic and Pacific oceans, including Torres Straits and north Queensland. It swarms massively in the Caribbean Sea and the Indo-Pacific Ocean during various times of the year causing nuisance stings. Outbreaks of stings from this jellyfish occur regularly in the south-eastern Florida Atlantic coast and the Caribbean during the spring. (Burnett, in Williamson *et al* 1996, p.198).

Appearance

Known as the `thimble jelly' or `button jellyfish' the bell is slightly brown with a maximum bell diameter of 20 mm diameter, slightly greater than its depth. The bell apex is flat and has vertical sides leading to eight short, thick tentacles.

The sting

Known as `seabather's eruption' or sea lice (Burnett; Fenner, in Williamson *et al* 1996, p 221, p308). Four to 24 hours after a sting, victims have a prickling sensation, often developing urticarial hive-like lesions. Symptoms occasionally take up to three or four days before the problem starts. The skin lesions may last seven to ten days; recurrences may occur with secondary eruptions after three to ten days. These lesions eruptions are worse in areas covered by the swimsuit.

Recurrent eruptions composed of urticarial or vesicular lesions may persist for up to a year (Tomchick *et al* 1993). Other problems reported include sore throat, cough, abdominal pain and diarrhoea. Fever, chills, headache, nausea, malaise and vomiting are rare but may occur in children (Moschella 1951). Conjunctivitis and urethritis may also accompany these symptoms and one case of prolonged blurred vision, nausea, lethargy, fatigue, tightness of breath, weakness and abnormal taste sensation has been reported (Burnett & Burnett 1990).

Prevention and treatment

Protective clothing may minimise symptoms. Swimming apparel should be tight fitting and removed on leaving the water. Wet suits should have restrictive cuffs (Tomchick *et al* 1993). Mentholated emollients may offer temporary relief, or high-potency topical corticosteroids should be applied twice daily. Topical or systemic antihistamines are ineffective and systemic corticosteroids are not warranted (Burnett, in Williamson *et al* 1996, p 222).

North America

Professor Burnett and colleagues continue to publish new information on jellyfish and their envenomation effects (see Appendix B). A recent paper from this group brings attention to the fact that eyes may be affected by nematocyst injuries to the cornea, causing burning corneal pain, tearing and photophobia, and may result in corneal oedema, and punctate epithelial keratitis. Iridocyclitis, increased intra-ocular pressure and decreased visual acuity may occur (Glasser *et al* 1992).

"Sea bather's itch" continues to occur and is reaching almost epidemic proportions in some areas (Burnett, in Williamson *et al* 1996, p 308).

The Caribbean Sea

As reported previously, *Carybdea alata* appears to be a problem in the seas around Puerto Rico. Also present in this region are *Carybdea marsupialis, Tamoya haplonema, Chiropsalmus quadrumanus* and *Tripedalia cystophora* (B Cuttress, 1993, personal communication).

5.7.9 North east Atlantic

see Map 2 – the Atlantic Ocean – human deaths and chirodropid distribution.

British Isles, France

Few serious stings are reported from the coast of the British Isles. Occasionally painful stings are reported in the English Channel which cause backache, anxiety, sweating and muscle cramps – similar to the Irukandji syndrome (see above). They are reported to be due to rhizostomes (jellyfish with no actual tentacles, but having eight arms)(Fenner, in Williamson *et al* 1996, p300). However, these jellyfish do not usually cause serious stings. Recent communications from Paul Cornelius (1996, personal communication) suggest that multi-tentacled *Physalia* spp (probably *P. physalis*) occur in Penzance each year, and thus in other beaches in the Cornwall area, and possibly further afield. *P. physalis* stings would cause a severe sting and these systemic symptoms.

Cyanea capillata

This jellyfish also occurs in these waters and extends into the North Sea. A treatment for `neuralgia' in Norway in the early part of this century was stinging from *Cyanea* tentacles, which were presumably abundant. However, after glottic oedema occurred on one patient this practice was abandoned (Cleland & Southcott 1965, p.151).

Another interesting, though fabricated, envenomation reported in the literature (albeit, fictional) was the case in `The Adventure of the Lion's Mane', a short story by Sir Arthur Conan Doyle. In this story he describes how Sherlock Holmes deduced that the cause of death of a victim found dead on an English Beach, covered in `whip marks' - and thought to have been scourged to death, was actually due to a *Cyanea*

sting (local name `Lion's Mane'). However, despite *Cyanea* spp. being found up to 2.6m in diameter (in the Antarctic Ocean)(Mayer 1910), a death has never been reported.

Stings must occur on the surfing beaches of France that face the Atlantic. However, despite surf lifeguards from Australia regularly working on these beaches, no records of stings have been able to be determined by the Author.

Portugal, Spain (west coast)

In August 1996 large numbers of swimmers were being stung by jellyfish identified by Professor Josep-Maria Gili (1996, personal communication) as *Pelagia noctiluca* and *Cotylorhiza tuberculata* – an unusual problem. The author became involved with these mass stings as advice was needed on the best way to treat victims. As described in the first aid section 5.8.3, as the main problem was localised skin pain, the best way to treat them was by ice, as cold packs were not readily available. However, with large numbers like this the quantity of ice needed can be a problem and the suggested treatment, which always seems to work well, probably on the psychological level, was to spray the stung area with seawater. The seawater gives a cooling effect that seems to help, and the effect of someone actually treating the sting with authority, is reassuring to victims.

Professor Rogério A F Gonzaga, MD, a surgeon wrote a major contribution on Portuguese marine envenomation (Gonzaga 1985) and has also prepared a short chapter for the Venomous and Poisonous Marine Animals (pp411-413).

Mediterranean

Dr Franco Kokelj of Trieste wrote extensively on the problem with jellyfish envenomation in the Mediterranean (see below).

There have been no deaths, but a lady suffered severe anaphylactic shock and was probably only saved as her bodyguards were close by and had almost instant access to medical aid and an adrenaline injection.

For many years the Mediterranean suffered with huge swarms of jellyfish, usually *Pelagia noctiluca*, which cause painful, problem stings rather than serious ones with systemic effects, or being life-threatening (except the case above!).

Other species causing mass swarming have been *Aurelia aurita, Chrysaora hysoscella* and *Rhizostoma pulmo* (Kokelj, in Williamson *et al* 1996, p.284-291). Recently *Rhopilema nomadica* was identified as a problem around Israel (Galil *et al* 1990), and a David Attenborough Nature Program in 1995 suggested that swarms of *Rhopilema* may head through the Suez canal (Attenborough 1994, unpublished observations). It seems that this jellyfish was not endemic in the area until after the opening of the Suez in 1869.

Another jellyfish appearing in swarms, especially in the summer of 1991 and 1994, was *Carybdea marsupialis.* It has caused `significant' stings in the Adriatic, but although it is a carybdeid reaching between 5-15cm bell diameter, it has not caused life-threatening stings to date (Kokelj, in Williamson *et al* 1996,p.285-286).

Dr Franco Kokelj of Trieste is leading a renewed medical interest in Mediterranean scyphozoans and has several recent publications (Kojelj *et al* 1989;1993a and 1993b; 1994; 1995; Kokelj & Burnett 1990). Studies on other important jellyfish in this region (*Chrysaora hysoscella*, *Aurelia aurita* and *Rhizostoma pulmo*) is current (Kokelj, in Williamson *et al* 1996,p284-289).