

**THE BLACK SPOT DISEASE IN
CRANGON CRANGON (L.)
OF THE GERMAN BIGHT**

Rainer Knust
Alfred-Wegener-Institute for Polar- and Marine Research
Coloumbus-Straße 2850 Bremerhaven
F.R.G.

- ABSTRACT -

The abundance of black spot disease of brown shrimp (*Crangon crangon* (L.)) was investigated in the German Bight from 1986 to 1988. Highest prevalences of these cuticular lesions were found in the inner German Bight, mainly in the estuaries of Elbe and Weser, with a maximum infection rate of 58%. Prevalence of disease was higher in larger specimens than in smaller ones. Disease intensity and infection rate were highest in late summer and autumn.

- INTRODUCTION -

The black spot disease is a necrotic shell disease of crustaceans first described by HESS (1937) and MANN & PIE-PLOW (1938). The characteristic colouration of this shell disease prompted the use of terms such as "pitted shell disease", "burn spots", "corroded spots", "black spot disease" or "black necrosis".

Histological examinations of diseased specimens showed, that all layers of the exoskeleton were eroded. Affected portions were brittle and easily fragmented, cracking and pitting of calcified layers occurred. Underlying tissues were often necrotic. This actual shell erosion seems to involve activity of chitinoclastic bacteria, with subsequent secondary infection of underlying tissue by facultative pathogens. An initial preparation of the exoskeleton by mechanical, chemical or microbial action is probably significant. Further particulars about pathology of black spots can be found in COOK & LOFTON (1973), GOPALAN & YOUNG

(1975), SINDERMANN (1977,1989), BAROSS et al. (1978), DOUGHTIE et al. (1983).

Black spot disease has been frequently observed in many different freshwater and marine crustacean species (Tab.1). First references about diseased shrimps (*Crangon crangon* (L.) in the North Sea were given bei MEIXNER (1967) and others, listed in Tab.2. This paper reports on the occurrence of black spot disease in *Crangon crangon* (L.) of the German Bight from 1986 to 1988. The investigation was carried out in the "Bundesforschungsanstalt für Fischerei" Cuxhaven F.R.G. and financial supported by the "Umweltstiftung WWF" Bremen F.R.G. (KNUST, 1988).

- MATERIALS AND METHODS -

From October 1986 to April 1988 samples from the area of the Elbe estuary were taken monthly by commercial fishermen. In January 1987 and 1988 sampling was carried out in the coastal waters of the German Bight near the 20m depth contourline (Fig.4 ,5) and a third time in August 1987 on the traditional fishing grounds of the commercial shrimp fisheries in the German wadden sea (Fig.6). To stop bacterial activity, shrimps were boiled immediately after collection. The samples were examined on board or in laboratory with a magnifying glass. A total of about 16000 shrimps were examined.

- RESULTS -

1. Infection rates and body size

In all samples the prevalence of disease was higher in larger specimens than in smaller ones. In April 1987 (Elbe estuary) the disease levels ranged from 4.4% in shrimps with 25mm total body length to 34.6% in animals with 60mm body length (Fig.1)(Fig.2).

2. Seasonal periodicity of disease frequency

In the Elbe estuary infection rate and the mean disease intensity (mean number of black spot per diseased individual) were measured monthly. The infection rate as well as the mean disease intensity showed distinct seasonal periodicities. In all size groups the infection rate was lowest from May to June and highest in late summer and autumn (Fig.2). The mean disease intensity increased slightly during the year and was highest in December with a mean number of 3.4 black spots per diseased individual (Fig.3).

3. Regional distribution

In winter catches (January 1987 and January 1988) the highest disease prevalences were found in the inner German Bight close to the estuaries of Elbe and Weser. The lowest were measured in the north of the German Bight and west off the "Ostfriesischen Inseln". In January 1987 the values ranged from 23.1% to 40.6%; in January 1988 from 5.4% to 27.8% (Fig.4 and 5).

In August 1987 the infection rates ranged from 23.5% to 57.8%. Areas with highest incidence of disease were observed in the estuaries of the rivers Elbe, Weser and Ems. The lowest infection rates were found in the north off the "Nordfriesischen Inseln" wadden and west off Borkum (Fig.6).

- DISCUSSION -

MEIXNER (1967,1968,1969), SCHLOTFELD (1972), DETHLEFSEN (1981) and SEITZ (1984) also investigated black spot disease in *Crangon crangon* (L.) off the German Bight (Tab.2). They observed lower infection rates than in this investigation, but this should not be interpreted as an increase of disease prevalence in the German Bight since 1967. The reason may be found in different methods of investigation. MEIXNER (1967) looked only for black scabs at the stumps of lost appendages and SCHLOTFELD (1972) only for greater ulcerative black spots. All four authors examined the shrimps without using magnifying glasses so that early stages of small black spots may be overlooked.

SCHLOTFELD (1972) and NOTTAGE (1982) described distinct seasonal periodicities of disease prevalence similar to those found in the Elbe estuary. SCHLOTFELD (1972) found maximum infection rates in shrimp from the eastern part of the German Bight in summer, NOTTAGE (1982) measured maximum rates in autumn in shrimp from the Irish Sea. This seasonal trend seems to be typical for diseases influenced by bacteria. WOLTHAUS (1984) reported a comparable seasonal periodicity for fin erosion and ulceration in dab (*Limanda limanda* (L.)) off the German Bight.

SINDERMANN (1989) considered the black spot disease in some way as the invertebrate analogue of fin erosion in fish and described the disease as the consequence of a disturbed balance between process of chitin maintenance and repair and the activities of chitinoclastic microorganisms. Environmental changes affect normal shell formation or favoring the growth of chitin-utilizing microbes. Such disturbances may be consequences of pollution. A number of recent publications report on an association of disease prevalence and environmental pollution in estuarine and

coastal waters (YOUNG & PEARCE, 1975; ESTRELLA, 1984). A detailed review of shell disease in crustaceans resulted in the general conclusion that "...prevalences have been found to be high in crustaceans from polluted sites; prevalences show trends similar to those of black gill syndrome, which also has a statistical association with extent of pollution. Experimental exposures of crustaceans to contaminated sediments, heavy metals; biocides, petroleum derivatives can result in the appearance of black gill syndrome, often accompanied by shell disease."(ANONYMOUS, 1989 cited in SINDERMANN, 1989).

In the German Bight the black spot disease in brown shrimp is common. Diseased animals were found at all stations. Areas with relative high disease prevalences were localized in the inner German Bight close to the estuarine areas of the rivers Elbe, Weser and Ems. These areas are considered as highly polluted. A comparison with the contamination of surface sediment with heavy metals in the German Wadden Sea, measured by SCHWEDHELM (1984), showed a statistically significant association between high black spot disease prevalence and increase concentrations of lead in the sediments (Fig.7).

- CONCLUSION -

The frequent occurrence of black spot disease in the German Bight, the high disease prevalences and the possible influence by human activities indicate that investigations about the black spot disease should be continue. Brown shrimp (*Crangon crangon* (L.)) seems to be qualified for monitoring this disease because expansive migration along the coast was not recorded (TIEWS, 1970).

Tab. 1 : DISSEMINATION OF BLACK SPOT DISEASE IN CRUSTCEANS

SPECIES	AREA	REFERENCE	
<i>Amphipoda</i>	Irish Sea	NOTTAGE	(1982)
<i>Callinectes sapidus</i>	Atlantic coast USA	COOK & LOFTON	(1973)
<i>Cancer irroratus</i>	Atlantic coast USA	SAWER et.al.	(1985)
	New Yorker Bight	YOUNG & PEARCE	(1975)
<i>Cancer pagurus</i>	Irish coastal waters	AYRES & EDWARDS	(1982)
	Southern North Sea	KNUST	(1988)
<i>Carcinus maenas</i>	French coastal waters	RAMIREZ-REREZ	(1980)
	Irish Sea	NOTTAGE	(1982)
<i>Chionoecetes tanneri</i>	Pazific coast USA	BAROSS et.al.	(1978)
<i>Corystes cassivelaunus</i>	Irish Sea	NOTTAGE	(1982)
<i>Crangon allmani</i>	German Bight	KNUST	(1988)
	Irish Sea	NOTTAGE	(1982)
<i>Crangon crangon</i>	Belgish coastal waters	VERVOOT et.al.	(1980)
	German Bight	DETHLEFSEN	(1981)
		KNUST	(1988)
		MEIXNER	(1967)
		SCHLOTFELD	(1972)
		SEITZ	(1984)
	Irish Sea	ABBOTT & PERKINS	(1977)
		NOTTAGE	(1982)
		PERKINS	(1974)
<i>Crangon septemspinosa</i>	New York Bight	GOPALAN & YOUNG	(1975)
<i>Homarus americanus</i>	New York Bight	YOUNG & PEARCE	(1975)
<i>Metapendaeus monoceros</i>	Bangladesh	KHAN et.al.	(1984)
<i>Macrobrachium rosenbergii</i>	(freshwater)	BURNS et.al	(1979)
<i>Macropipus holsatus</i>	Irish Sea	NOTTAGE	(1982)
	Southern North Sea	KNUST	(1988)
<i>Pandalus montagui</i>	Irish Sea	NOTTAGE	(1982)
<i>Penaeus spp.</i>	Atlantic coast USA	COOK & LOFTON	(1973)

Tab. 2 : BLACK SPOT DISEASE PREVALANCES IN BROWN SHRIMP
(*Crangon crangon* (L.))

REFERENCE	AREA	DISEASE PREVALENCE
MEIXNER (1967)	east German Bight	16%
SCHLOTFELD (1972)	east German Bight	1% - 9%
VERVOORT et.al. (1980)	Belgish coastal waters	16% - 35%
DETHLEFSEN (1981)	Elbe estuary	2% - 23%
NOTTAGE (1982)	Irish Sea	5% - 26%
SEITZ (1984)	east German Bight	10% - 16%
	Elbe estuary	14% - 17%
	southwest German Bight	20% - 22%

Fig.1: BLACK SPOT DISEASE PREVALENCE
IN CRANGON CRANGON (L.)
- DIFFERENT SIZE GROUPS -

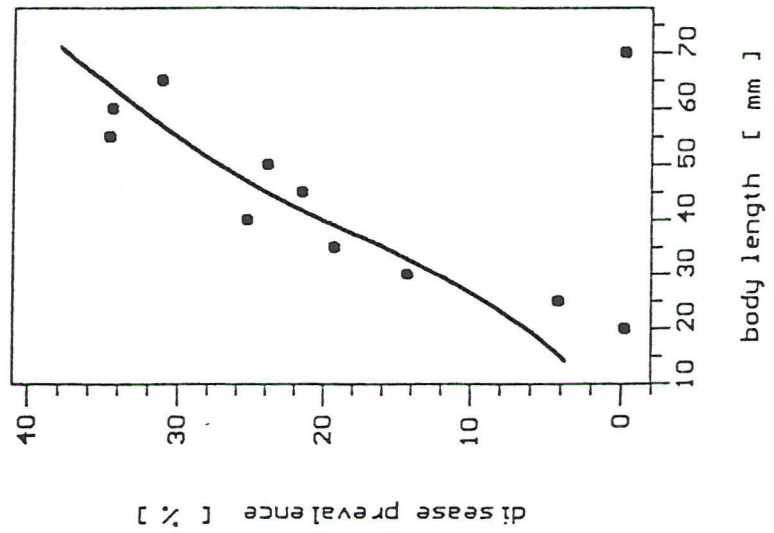


Fig.2: SEASONAL PERIODICITY OF BLACK SPOT DISEASE
PREVALENCE IN CRANGON CRANGON (L.)
- ELBE ESTUARY 1987 -

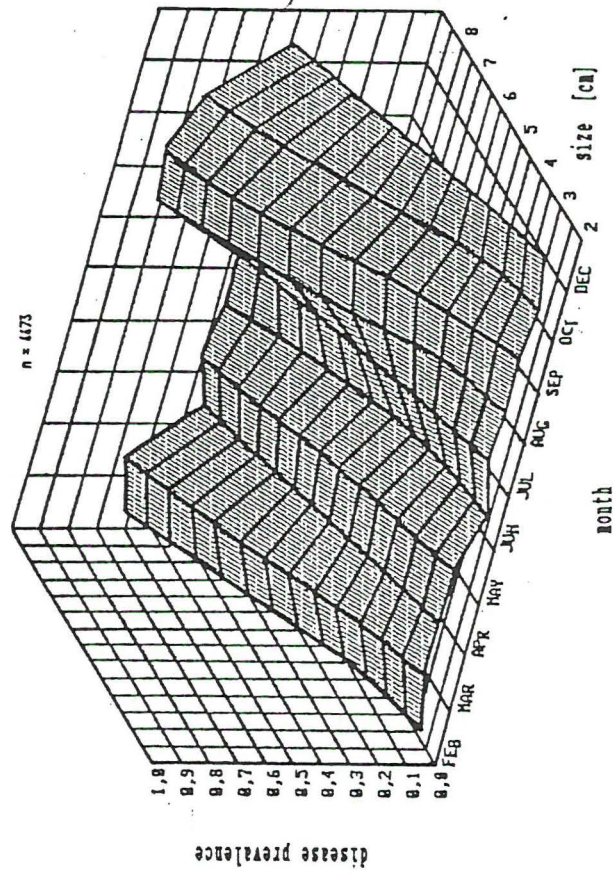


Fig. 3: DISEASE INTENSITY OF BLACK SPOT
 IN CRANGON CRANGON (L.)
 - ELBE ESTUARY 1987-1988 -

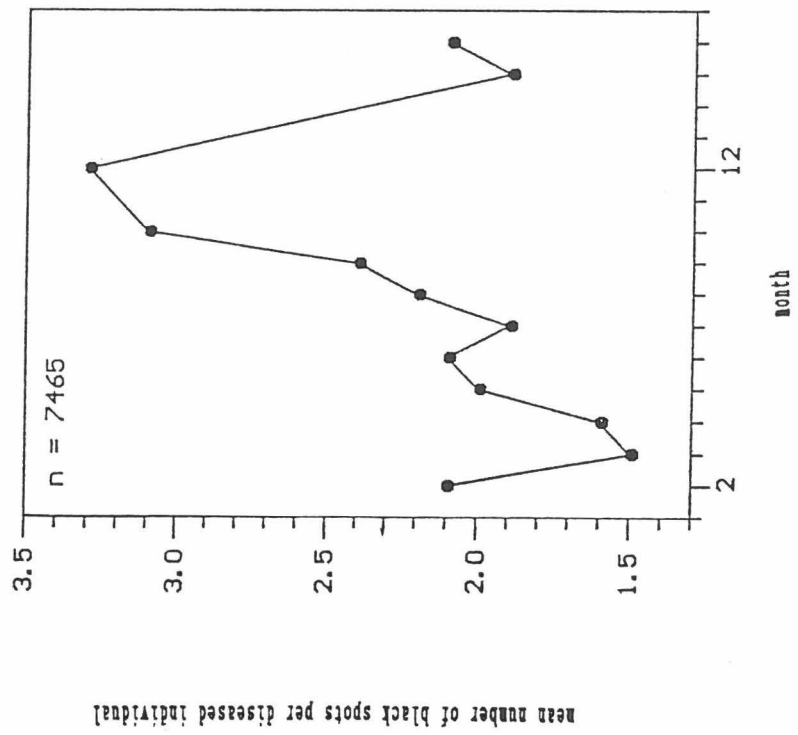


Fig. 4: BLACK SPOT DISEASE PREVALENCE
 IN CRANGON CRANGON (L.) OF
 THE GERMAN BIGHT
 - JANUARY 1987 -

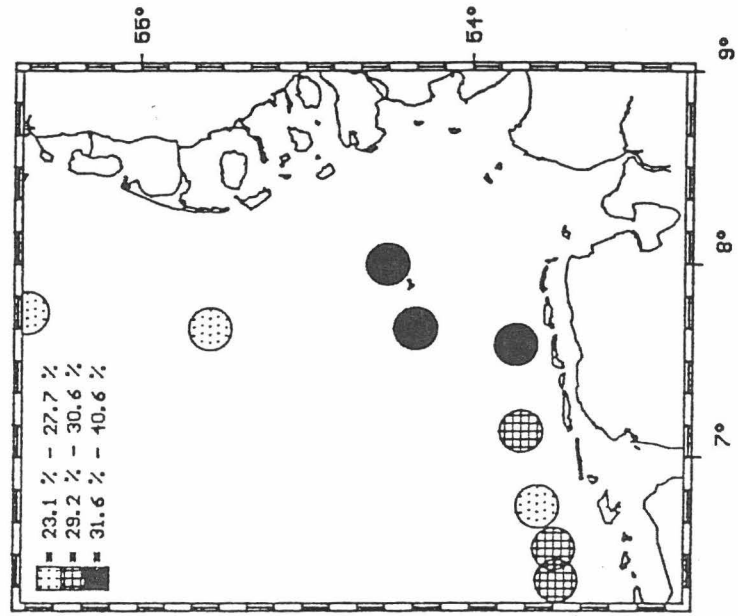


Fig. 6: BLACK SPOT DISEASE PREVALENCE
IN CRANGON CRANGON (L.) OF
THE GERMAN BIGHT
- AUGUST 1987-

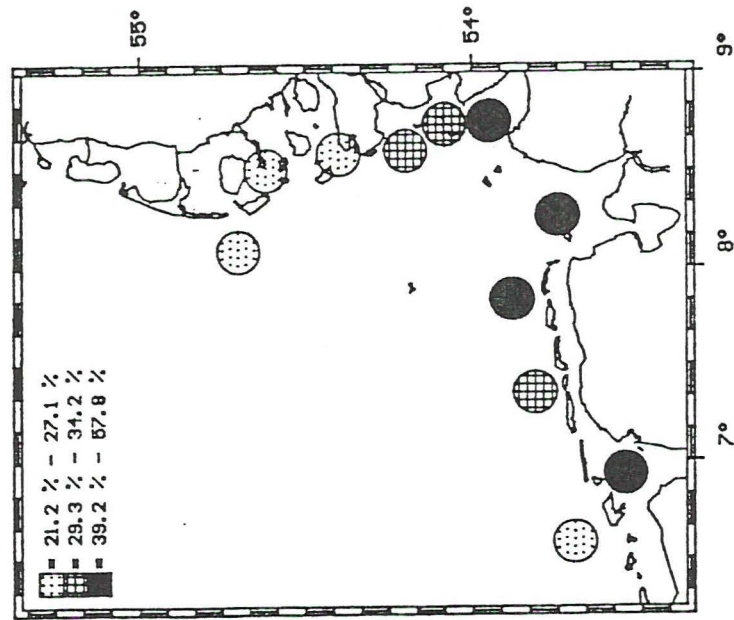


Fig. 5: BLACK SPOT DISEASE PREVALENCE
IN CRANGON CRANGON (L.) OF
THE GERMAN BIGHT
- JANUARY 1988-

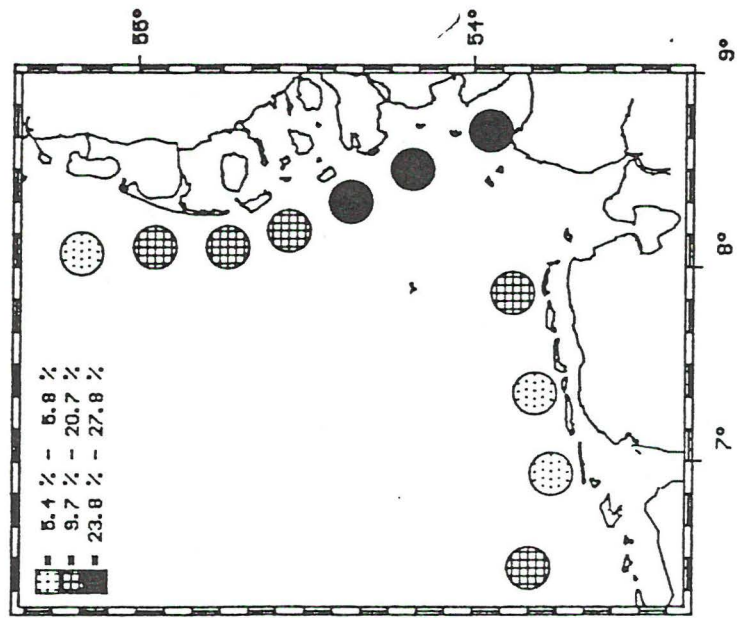
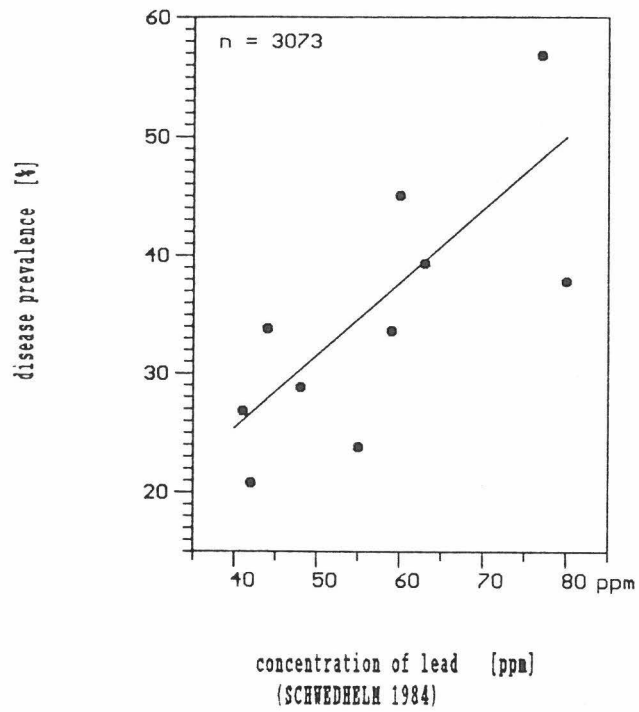


Fig.7: BLACK SPOT DISEASE PREVALENCE
IN *CRANGON CRANGON* (L.) AND
CONCENTRATION OF LEAD IN THE
SEDIMENTS
- GERMAN BIGHT -



- REFERENCES -

- Abbott, O.J. and Perkins (1977): The biology of the brown shrimp *Crangon crangon* in the Solway Firth. Cumbria Sea Fisheries Committee Scientific Report 77/4. The Courts, Carlisle
- Ayres, P.A. and E. Edwards (1982): Notes on the Distribution of "Black Spot" Shell Disease in Crustacean Fisheries. *Chemistry in Ecology*, 1982 Vol 1, 125-130
- Baross, J.A.; Tester, P.A. and Morita, R.Y. (1977): Incidence, Microscopy, and Etiology of Exoskeleton Lesions in the Tanner Crab, *Chionoectes tanneri*. *J. Fish. Res. Board Can.*, Vol. 35, 1141-1149
- Burns, C.D.; M.E. Berrigna and G.E. Henderson (1979): *Fusarium* sp. infections in the freshwater prawn *Macrobrachium senbergii* (De Man). *Aquaculture* 16, 193-198
- Cook, D.W. and S.R. Lofton (1973): Chinoclastic bacteria associated with shell disease in *Penaeus* shrimp and the Blue Crab *Callinectes sapidus*. *J. Wildl. Dis* 9, 154-159
- Dethlefsen, V. (1981): Untersuchungen zur Schädigung und Akkumulation von Kombinationen von Schwermetallen, Pestiziden und Detergentien an embryonalen und Larvenstadien mariner Organismen zur Festlegung der Wasserqualitätskriterien. Abschlussbericht BMFT-Förderungskennzeichen MFU0317-2
- Doughtie, G.D.; P.J. Conklin and K.R. Rao (1983): Cuticular Lesions Induced in Grass Shrimp Exposed to Hexavalent Chromium. *J. Invertebr. Pathol.* 4, 249-258
- Estrella, B.T. (1984): Black gill and shell disease in American lobster (*Homarus americanus*) as indicators of pollution in Massachusetts Bay and Buzzards Bay, Massachusetts. *Mass. Dept. Fish Wildl. Rec. Veh., Div. Mar. Fish. Publ. No. 14049-19-125-5-85-C.R.*, 17pp.
- Hess, E. (1937): A shell disease in lobsters (*Homarus americanus*) caused by chitinivorous bacteria. *J. Biol. Bd Canada* 3, 358-362
- Khan, Y.S.A.; Hakim, A.; Zamal, H.; Anwar, H. (1984): Bacterial Black Spot Disease of Shrimp (*Metapenaeus monoceros*) in Bangladesh. *Mahasagar*. 17, 125-127.
- Knust, R. (1988): Schwarzfleckenkrankheit bei der Garnele (*Crangon crangon* (L.)) in der Deutschen Bucht. Projektabschlussbericht der Umweltstiftung WWF-Deutschland und der Bundesforschungsanstalt für Fischerei Cuxhaven
- Mann, H. und U. Pieplow (1938): Die Brandfleckenkrankheit bei Krebsen und ihre Erreger. *Fischer* 36, 225-240
- Meixner, R. (1967): Some observations on Injuries and Regenerates of Shrimp *Crangon crangon* (L.). ICES CM:1967/K:19 Shellfish and Benthos Committee
- (1968): Verletzungen und Regenerate in Fangproben von *Crangon crangon* (L.) (Crustacea, Natantia). *Arch. Fischereiwiss.* 19(1), 56-61

- (1969): Is there a Spot Disease in *Crangon crangon* (L.). ICES CM 1969/K:15 Shellfish and Benthos Committee
- (1970): Grössenzunahme bei der Hautung von *Crangon crangon* aus der Nordsee und Ostsee. Ber.Dt.Wiss.Komm.Meeresforsch. 21, 393-398
- Nottage, A.S. (1982): Shell Disease of Brown Shrimp (*Crangon crangon* (L.)), and other Marine Crustacea from the Solway Firth. Chemistry in Ecology 1, 107-123
- Perkins, E.J. (1974): The Biology of the Estuaries and the Coastal Waters. Academic Press, London
- Ramirez-Perez, E.; A. Amargier and C. Vago (1980): Ulcerations cuticulaires chez les Crustacés Décapodes marins. C.R.Acad.Sc.Paris, t 291
- Sawer, T.S.; E.J. Lewis; M. Galasso and B. Shown (1987): Black Gill Conditions in the Rock Crab *Cancer irroratus* as Indicator of Ocean Dumping in the Atlantic Coastal Waters of the United States. ICES Special Meeting on Disease of Commercially Important Marine Fish and Shellfish No.60
- Schlotfeld, H.J. (1972): Jahreszeitliche Abhängigkeit der "Schwarzfleckenkrankheit" bei der Garnele, *Crangon crangon* (L.). Ber.d.t.wiss.Kommn.Meeresforsch. 22(3), 397-399
- Seitz, H.U. (1984): Phänologie der Schwarzfleckenkrankheit von *Crangon crangon* L. (Decapoda, Crustacea) in der südlichen Deutschen Bucht. Examensarbeit der Universität Hamburg (Juli, 1984)
- Sindermann, C.J. (1977): Recent data on possible associations of coastal/estuarine pollution with fish and shellfish diseases. ICES CM 1977/E:14 Fisheries Improvement Committee
- (1989): Pollution-associated diseases in estuarine/coastal fish and shellfish: A status report and perspective for the 1990's. ICES C.M.1989/E:26, 37pp.
- Schwedhelm, E. (1984): Schwermetalle-Bioelemente in den Nordsee-Watten und in der Jade und die Tonmineralverteilung in den Sedimenten der südöstlichen Nordsee. Diss.Heidelberg
- Tiews, K. (1970): Synopsis of the biological data of common shrimp *Crangon crangon* (Linnaeus, 1758). FAO Fisheries Synopsis No.91, 1167-1224.
- Vervoort, D.; F. Redant and D. Declerck (1980): Causes and incidence of the "black spot disease" on brown shrimp (*Crangon crangon*). ICES CM 1980/K:34 Shellfish Committee
- Wolthaus, B.-G. (1984): Seasonal changes in frequency of diseases in dab, *Limanda limanda*, from the southern North Sea. Helgoländer Wiss. Meeresunters. 37, 375-387.
- Young, J.S. and J.B. Pearce (1975): Shell Disease in Crabs and Lobsters from New York Bight. Mar.Poll.Bull. 6(7), 101-105