

When Judy returned to college in September, we moved the pup down to the Dolphin and Sea Lion Pool and under the care of Art Thomas. Art has a rare talent for the care of sea lions, so we felt that this would be a good match. Since September, Art has been caring for Hulk. The pup has been given goldfish and other small fish in an attempt to get him on solid food. In the first week of January, we eliminated all but fish and water from the formula. We were concerned about the effects of the formula over a long period of time. We were not too concerned that the pup had no interest in eating solid food.

At the time of closing this report (1 April 1975) our pup is ten and a half months old and weighs sixty pounds. He eats about five pounds of blended fish each day. The hole in the nipple of his bottle has been adjusted from a hole approximately 1/16" in diameter to 3/8" in diameter.

Epilogue

About one week after our pup was born, another pup was born in the feeder pool. We separated the mother and pup from the rest of the group. The pup appeared strong and the mother seemed to have every intention of taking care of her pup. It is interesting to note that when feeding the mother sea lion herring and smelt, if the pup takes a herring and runs away, the mother will retrieve the piece of fish. The body size between the two pups seems to be identical. We have not attempted to restrain the mother-reared pup to weigh him. We felt that unless an obvious problem occurred we would let the mother care for her pup.

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THE PATHOGENESIS AND ETIOLOGY OF ULCERATIVE SHELL DISEASE IN TURTLES

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Summary

The etiologic agent of ulcerative shell disease (Shell rot) of turtles, *Beneckeia chitinovora* is isolated and used to reproduce the typical clinical disease syndrome in the laboratory.

The morphology, biochemistry and the natural history of the causative organism of ulcerative shell disease is presented to the veterinary literature.

A control and preventive management program for ulcerative shell disease is presented based on experimental results and the natural history of the causative organism.

Ulcerative shell disease (USD-Syn. Shell rot, spot disease or Rust) is a highly infectious malady of free ranging and captive turtles. Ulcerative shell disease primarily affects the chitinous plates of both the carapace (dorsal shell) and plastron (ventral shell) and tends to be contagious, chronic, self-limiting disease; however, secondary infections will often kill the affected turtle. Animals that survive and spontaneously recover have a permanently pitted or pocked shell. Historically, the disease has been thought to be caused by a "fungus", however, no specific organisms were identified except *Candida albicans* and standard treatments have been ineffective.

Case Report

An outbreak of typical USD occurred in a mixed turtle exhibit in a zoological park. Typical lesions occurred in all species displayed, but appeared most severe in the spiny soft shell turtles.

Early lesions in sliders, red-eared turtles, musk turtles, soft shell turtles, side-neck turtles and painted turtles were characterized by a blotchy dark discoloration of the affected shell plate - this was most noticeable on the plastron where the plates were normally a pale cream to yellow color. The plates loosened around the sutures and sloughed off leaving raw punctate ulcerations ranging in size from 1 to 12 mm in diameter. As the disease progressed, the floor of the ulcer became covered by a pseudo-membrane yellow to tan in color. The pseudo-membranes were peeled away and several samples collected from the base of the craters for culture. The soft shell turtles were covered with lesions in all stages of development. Samples were taken from several of the fresh lesions and the healing lesions.

TABLE I. Biochemistry and morphology of *Beneckea chitinovora* 1,2

O.T. ×	Hemolysis	Gas	Liquefies gelatin	Nitrate production	Motility	Citrate utilization
20°C	Beta	+	+	+	+ hanging drop	+
Urease	Indol	H ₂ S	Lysin decarboxylation	litmus milk acid	NaCl	Morphology
-	+	+	+		Growth in 1-4% NaCl inhibited reg. 6.5	Rods 0.75 to 2.0 μ pairs and short chains, peritrichous flagella.
Gram stain	Glucose	Sucrose	Peptone-chitin media	Peptone broth		
Negative	Acid	Acid	Produces ammonia	turbid with heavy slimy, whitish to brown pellicle		

× O.T. : optimum temperature

All samples were plated on blood agar and incubated at 37°C and 24°C. All platings incubated at 37°C were overgrown with *Proteus* sp. in 12 to 24 hours. Those samples incubated at 24°C produced pure cultures of a gram negative bacillus identified as *Beneckeia chitinovora* (syn-*Bacillus chitinovorius*) based on biochemistry and morphology (Table 1) (Campbell, 1974, and Rosen 1970) .

Pure cultures of *B. chitinovora* isolated from the clinical cases were inoculated into superficial scarifications mechanically produced in the carapace plastrons of healthy laboratory held painted turtles and soft shell turtles, inoculated i.m., and used to contaminate aquarium water ; a fourth group was kept as a control. Because *B. chitinovora* produced shell disease is an important disease of crustaceans (Campbell 1974, and Rosen 1970) pure cultures were also inoculated into the abdominal cavities and scarifications in the exoskeletons of laboratory crayfish.

Results and discussion

Severe lesions of USD were produced in the soft shelled turtle with mechanically produced shell injury and moderate lesions were produced in the equivalent painted turtles. Those turtles that were inoculated i.m. developed thin walled abscesses at the inoculation site as well as shell lesions. The turtles kept singly in *B. chitinovora* contaminated water and singly as control group did not develop lesions. The experimental lesions tended to be more severe than the naturally occurring lesions. The experimental lesions began at the inoculation site and spread over the shell without apparent pattern. The crayfish showed superficial USD lesions and died in 1 to 3 months.

Sample material was collected for culture from early USD lesions in the experimental soft shelled turtles, from the experimental painted turtles and from the abdominal cavities of the dead crayfish. The organism *B. chitinovora* was recovered in pure culture on blood agar at 24°C from the soft shelled turtles and the crayfish but not the painted turtles.

Beneckeia chitinovora produced USD is an important economic disease process of cultured and free ranging shell fish. Ulcerative shell disease has been reported in crayfish, lobster, blue crab, king crab and the hairy hand crab (Campbell 1974, and Rosen, 1970). *Beneckeia chitinovora* has been cultured from dead crustaceans and their debris (Campbell, 1974, and Rosen 1970).

The fulfilling of Koch's principles in the above described investigations has demonstrated that USD in turtles is also caused by *B. chitinovora*. This work shows the pathogenesis of USD in turtles depends upon the presence of *B. chitinovora* and a source of injury to the integrity of the turtles' skin or shell.

Proper chemotherapy remains a mystery ; however, the pathogenesis of USD and the natural source of *B. chitinovora*, the causative organism, is now understood and certain management measures can reduce the rate at which USD occurs and spreads in colonies of captive turtles :

1. isolate newly acquired turtles for 2 weeks prior to introduction into the colony ;
2. Do not feed crayfish, shrimp or shrimp meal to turtles or house living crustaceans with them ;

3. Isolate individual turtles showing early lesions ;
4. Provide sufficient basking and water space for each turtle to reduce the possibility of shell injury ;
5. Curette active and benign lesions and cauterize with tincture of iodine.

References

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A SURVEY OF PARASITES, BACTERIA AND VIRUSES ASSOCIATED WITH TROPICAL FISH IMPORTED FROM SOUTHEAST ASIA

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Summary

Approximately 600 million tropical fish are imported into the continental United States each year. The objective of this study was to evaluate the potential ecological impact which these fish and or the water in which they are shipped could have on the health of humans, domestic animals or native fish species. In this study, 16 shipments originating in Hong Kong, Taiwan, Singapore, and Bangkok were examined for presence of parasites, bacteria, and viruses. A total of 77 bags of fish were examined.

Methods

Parasitological examinations :

Five fish from each bag of fish were examined following standard methods (Reichenbach-Klinke, 1973) of dissection and examination. Wet mounts of gills, skin and fin scrappings, and internal organs were examined using 5 and 10 magnification objectives.