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2. Underwater TV and Still Camera Works in the Habitat of *Nautilus* off Suva, Viti Levu, Fiji

by

Mutsuo HATTORI[1], Kazushige TANABE[2] and Kimihiko ŌKI[3]

In mid-September, 1983, the time lapse camera works making use of the bait (small tuna) to attract nautili at four stations and TV and still camera works at three stations off Suva were successively carried out on the bottom between 185 and 420 meters in depth (Fig. 1). These works gave the pictures clearly showing the features of bottom sediments and the presence of megafauna on the seabed.

At two of the four baited camera stations (SV-18 and SV-22), *Nautilus pompilius* clinging to the bait fish or shrimps (*Heterocarpus*) gathering around the bait was pictured both on the 420 meters deep bottoms (Pl. 4, fig. 4; Pl. 6, figs. 1, 2).

Underwater TV and Still Camera Hardware

The underwater TV and the still camera used were designed and manufactured by the senior

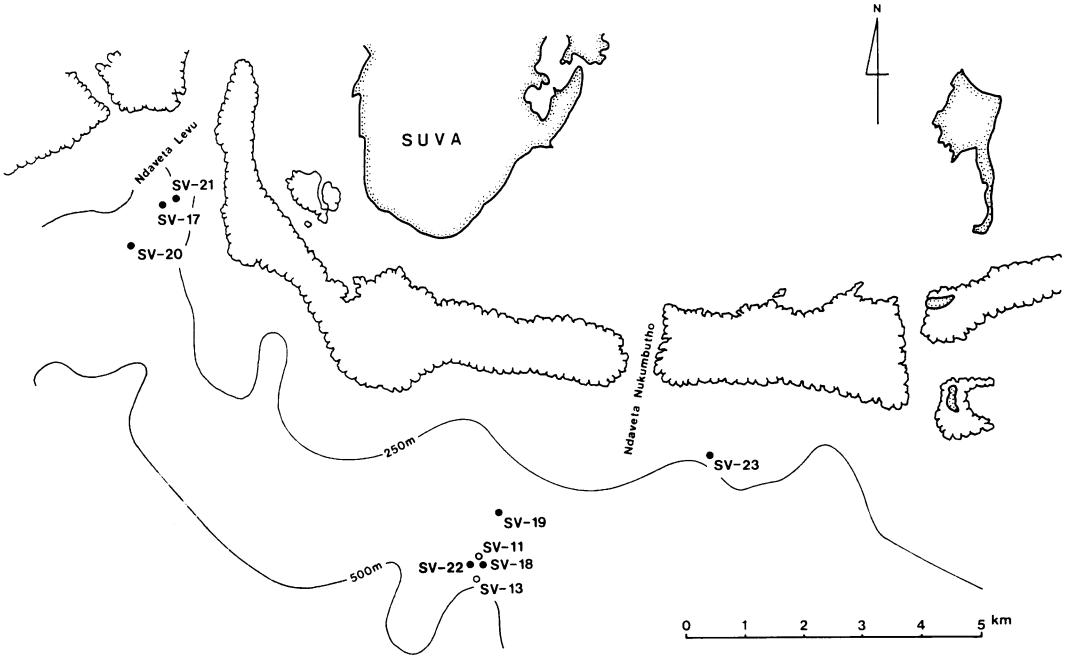


Fig. 1. The stations of underwater TV and still camera works (solid circle) and the neighbouring stations for trapping *Nautilus* (open circle).

1) Japan Marine Science and Technology Center, Yokosuka 237, Japan.
2) Department of Earth Sciences, Facrlty of Science, Ehime University, Matsuyama 790, Japan.
3) Institute of Earth Sciences, Faculty of Science, Kagoshima University, Kagoshima 890, Japan.

writer (M. HATTORI). Those were designed small and simple for the convenience of transportation by airplane. Specifications of the underwater TV and the still camera are described below.

Specifications of the Underwarter TV

Pressure case	ϕ 100 × 280(L) mm, alluminum (A1-6061-T6) cylinder shape pressure case with pyrex glass dome port.
Weight	4 kg
Operational depth	1000 m
TV camera	Hitachi VKC-1000 CCD(CMOS) color TV with 8.5 mm lens, auto iris
Resolution	260 lines
Sensitivity	100 lux
Power source	12 VDC, UM-1 × 8
Light	100 W, 12 VDC, Halogen lamp, UM-1 × 40
Coaxial cable	500 m (3c-2v)

Specifications of the Still Camera

Pressure case	ϕ 146 × 227(L) mm, cylindrical aluminum (A1-6061-T6) pressure case with acrylic plastic flat type camera port.
Weight	4 kg
Operational depth	500 m
Camera	Olympus OM-2 with winder, 50 mm lens and data chamber (day, time, minute)
Viewing angle	35 degree diagonal (in water)
Timer	Analogue type timer, preset 30 min. drive every 1 and/or 5 minutes
Electoronic flash (Strobe)	Olympus quick auto 310 in a pressure case, GN 34

Underwater TV and still camera were fixed to a frame which was made by the machine shop of the Institute of Marine Resources at the University of the South Pacific (USP). Arrangement of the underwater TV and the still camera on the frame is shown in Fig. 2. Plane and side views of still camera and strobe are shown in Fig. 3.

Still camera and strobe were fixed to a frame designed for the underwater still camera of the Institute of Marine Resources, USP, and a stick to which a bait fish was fixed was welded to the frame (Fig. 4).

Results of the TV and the Still Camera Works

TV and still camera were used during its slow descent for the behavioral observations of the *Nautilus* specimens which have been obtained by the previous trapping and for observations of the

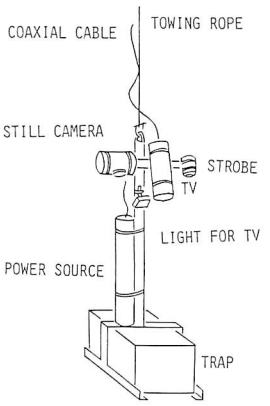


Fig. 2. Arrangement of underwater TV and still camera.

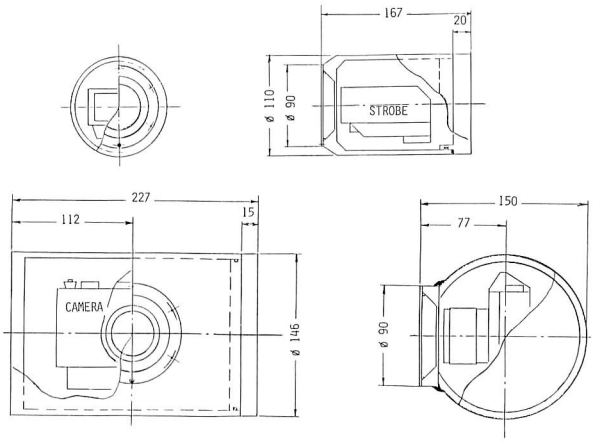


Fig. 3. Plane and side views of still camera and strobe.

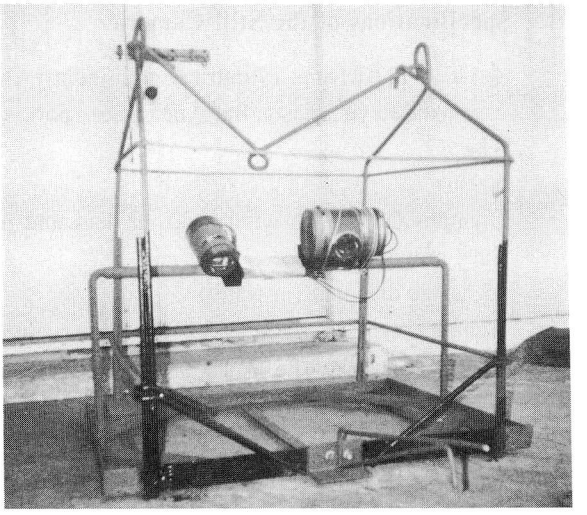


Fig. 4. Still camera and strobe fixed to the frame.

sea floor as well. In every trial, one specimen of *Nautilus* was kept in a cage installed below the frame (Fig. 2).

Three trials were carried out at the three stations (SV-19, SV-21 and SV-23) shown in Fig. 1 ranging from 185 to 350 meters in water depth.

Because of rough conditions of the sea and improper state of towing gear, the results of TV observations were not so fruitful. The coaxial cable for TV twined round a towing rope was apt to be teared off in the course of heaving up the frame partly owing to rough conditions of the sea and to very high elongation rate of towing rope in contrast to that of the cable attached to it. However, the observations of *Nautilus* in the trap were practicable while the cage is going down

and on the bottom.

The VTR records and the pictures of still camera showed up-and-down motions of *Nautilus* in the cage owing to the elevator motions of the supporting ship by the waves and the behavioral changes of *Nautilus* with depth increase were not clarified.

Fig. 1 in Plate 3 shows the picture from the VTR records and Fig. 2 in Plate 3 shows the picture by still camera.

Results of the Baited Camera Works

Baited camera works were carried out at four stations (SV-17, SV-18, SV-20 and SV-22), two of which (SV-17 and 20) are sited near Ndaveta Levu passage and the water depths are both 335 meters. The other two stations (SV-18 and SV-22) are located off Ndaveta Nukumbutho passage with the depths both of 420 meters, about 200 meters apart from the trap station SV-11 where many living nautili were captured. These stations are shown in Fig. 1.

Two or three frozen whole bodies of small tuna were used for bait at all stations tightly fixed to a stick welded in front of the still camera.

The timer of still camera was always set with 30 minutes preset time and 5 minutes recycle time so that about 25 to 33 shots of bottom pictures were taken for 2 hours 10 minutes or 2 hours 39 minutes. Those pictures were taken within the time range from the early evening (16 : 17) to night (21 : 29).

Results of the baited camera works at four stations are described below.

Station SV-17 : near Ndaveta Levu passage (entrance to the Suva Harbour)(Pl. 3, figs. 3-8).

Depth : 335 m.

Date : 12th September, 1983.

Time range of pictures : 19 : 10 to 21 : 29

Bottom : surface irregular ; whitish grey to light brown colored pebble to cobble sized mud balls were scattered on muddy bottom.

The first appeared organism was a shrimp which came into view just after the landing of the frame on the bottom. Several kinds of shrimps are observed in the pictures taken at this station (Pl. 3, figs. 3-8).

Two shots of pictures taken at 35 minutes after landing show only a cloud of bottom mud stirred up by feeding actions of fishes, and further 10 minutes after, baits are totally disappeared (Pl. 3, fig. 7) suggesting that some kind of big fish stole the baits.

The shrimps belonging to *Heterocarpus* and *Plesionika* are shown in Plate 3.

Station SV-18 : off Ndaveta Nukumbutho passage, near the trapping station SV-11 (Pl.4, figs. 1-6).

Depth : 420 m.

Date : 13th September, 1983.

Time range of pictures : 18 : 02 to 20 : 41.

Bottom : smooth but considerable numbers of mounds and pits are present. Grey to light brown colored muddy sand.

At 5 minutes after landing a kind of shrimp was pictured first (Pl. 4, fig. 1). Shrimps (*Heterocarpus*) began to feed the baits after 15 minutes and continued feeding until the last shot of the picture. At 25 minutes after landing, a brittle star was pictured (Pl. 4, fig. 2).

One hour and 24 minutes after landing, a small *Nautilus* was pictured (Pl. 4, fig. 4). The *Nautilus*, which is immature with maximum diameter of about 10 cm, seems to catch the shrimps.

Two hours and 4 minutes after landing, a crab was picutured to traverse the field of view(Pl. 4, fig. 6).

Station SV-20: near Ndaveta Levu passage (Pl. 4, figs. 7 and 8; Pl. 5, figs. 1-4).

Depth: about 337 m.

Date: 14th September, 1983

Time range of pictures: 16: 17 to 18: 20.

Bottom: gently sloping bottom with a few mounds and pits.

A kind of shrimp is present in the first picture. First appearance of fish was at 17 minutes after landing (Pl. 4, fig. 7) and after 21 minutes a big fish stole the whole baits(Pl. 4, fig. 8). Beard fish, yellow striped goat fish, flower job fish and a kind of shrimp are pictured at this station. They are shown in Plate 5, figs. 1-4.

Dr. Kimiyoshi HAYASHI of the Yokosuka City Museum, Kanagawa Prefecture kindly spared time for identification of those fishes.

Station SV-22: off Ndaveta Nukumbutho passage, near the trapping station SV-11 (Pl. 5, figs. 5-8; Pl. 6, figs. 1-8).

Depth: 420 m.

Date: 15th September, 1983.

Time range of pictures: 15: 54 to 18: 18 (landing time 15: 47).

Bottom: rather smooth but with gentle relief of mounds and pits.

Frame of the still camera was moved or changed in its direction by pushing with a fish head at one hour and 51 minutes after landing. Bottom shows slightly irregular surface with pebble to cobble sized blocks, after the minor dislocation of the frame.

The first appearance of fish (beard fish) was at 5 minutes after landing on the bottom (Pl. 5, fig. 5). About 30 minutes after landing, a large part of the bait is disappeared (Pl. 5, fig. 7), but the heads of the baits are still present because they were fixed tightly by wire through their eyes.

47 minutes after landing, the first *Nautilus* was pictured (Pl. 5, fig. 8), and 1 hour 22 minutes after landing, a *Nautilus* clinging to the bait was pictured (Pl. 6, fig. 1). The *Nautilus* (about 14 cm in maximum diameter) had continued to feed the bait for more than 15 minutes (Pl. 6, figs. 2-4). After that a deep sea shark (*Centrophorus* sp.) attacked the baits or *Nautilus* (?) (Pl. 6, fig. 5) and the *Nautilus* has not been pictured since then.

The fishes pictured at this station are beard fish, *Centrophorus* sp. and rubby snapper (Pl. 5, fig. 7; Pl. 6, figs. 2, 5, 6, 7 and 8).

Concluding Remarks

Three trials of the TV and the still camera works have not provided fruitful results. But the

works by means of the baited time lapse camera produced some interesting results.

The first organisms (shrimp) came into the view between 0 and 5 minutes after landing and the first fish appeared between 5 and 35 minutes. The large parts of the baits were disappeared between 21 and 35 minutes at the three stations.

Nautilus was pictured at the two stations, SV-18 and SV-22. Around those stations, traps (SV-11 and SV-13) have collected considerable numbers of *Nautilus* and *Heterocarpus*. At the Stations SV-17 and SV-20 near Ndaveta Levu passage where no living *Nautilus* has yet been captured, no *Nautilus* was pictured.

The first appearance of *Nautilus* were between 47 minutes and 1 hour 24 minutes, while the time range of feeding or clinging to the baits or shrimps (*Heterocarpus*) was between 1 hour 22 minutes and 1 hour 24 minutes.

A shark (*Centrophorus* sp.) was pictured between 1 hour 41 minutes and 2 hours 10 minutes. Details are summarized in Table 1.

Table 1. Times of occurrences of some events in the field of view of the baited time lapse camera after its settling on the bottom at each stations.

Station Depth	SV-17 335 m	SV-18 420 m	SV-20 337 m	SV-22 420 m
Date	12th Sept.	13th Sept.	14th Sept.	15th Sept.
Time Range for Operation	19 : 10 ⌇ 21 : 29	18 : 02 ⌇ 20 : 41	16 : 17 ⌇ 18 : 20	15 : 54 ⌇ 18 : 18
First appearance of shrimp	0 min.	0 min.	0 min.	5 min.
First appearance of fish	35 min.	— —	17 min.	5 min.
Disappearance of the bait	35 min.	— —	21 min.	30 min.
First appearance of *Nautilus*	— —	84 min.	— —	47 min.
Clinging of *Nautilus* to the bait	— —	84 min.	— —	101 min.
First appearance of shark	— —	— —	— —	101 min.

It might be concluded that at the sites where *Nautilus* and *Heterocarpus* were captured the baited camera provided the pictures of *Nautilus* and *Heterocarpus*, and this suggests a close relationship of *Nautilus* with *Heterocarpus*.

Although the writers had not much time for this work unfortunately, much more data shall be provided by making use of a variety of gears and multiple sets in future.

Explanation of Plate 3

(Times of pictures described are all after landing of the frame for underwater still camera on the sea bottom)

Station SV -23

Fig. 1. Photograph of nautilus and bait fishes put in a slowly descending cage for observation, adopted from underwater TV picture. Depth about 50 m.

Fig. 2. Photograph of the same things as the above, taken by underwater still camera. Depth about 150 m.

Station SV -17 (Depth 335 m)

Fig. 3. 5 min.

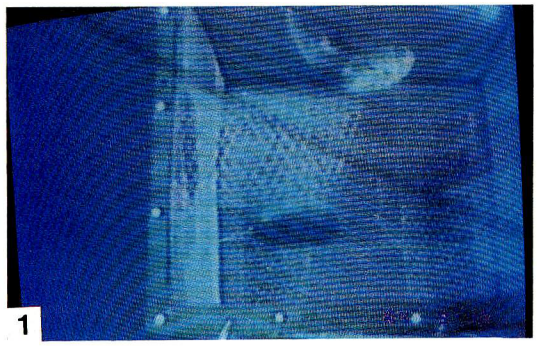
Fig. 4. 20 min.

Fig. 5. 25 min.

Fig. 6. 30 min.

Fig. 7. 1 hr. 14 min. Since 45 minutes after landing, bait fish has been totally disappeared.

Fig. 8. 1 hr. 39 min.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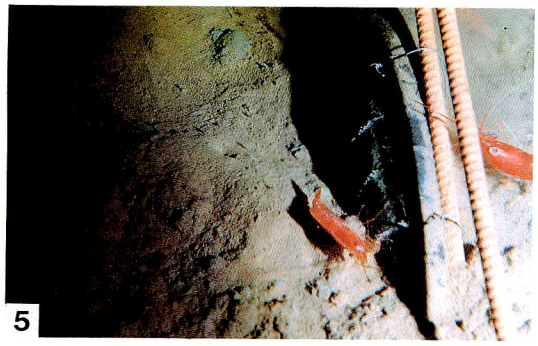
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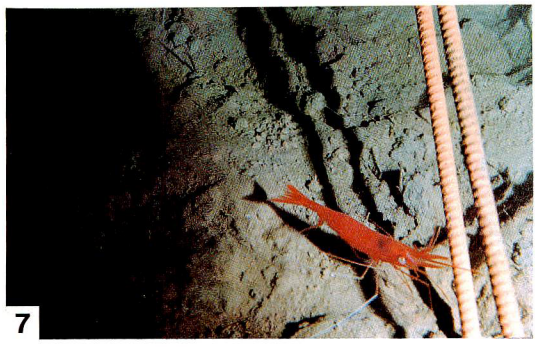
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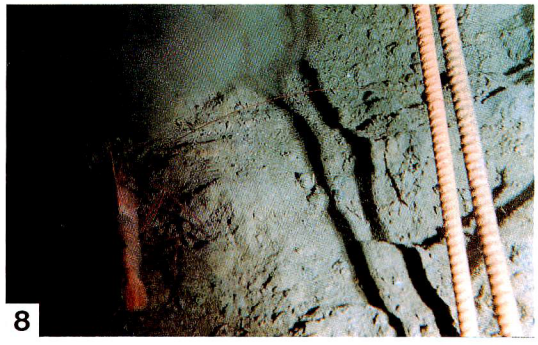
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Explanation of Plate 4

(Times of pictures described are all after landing of the frame for underwater still camera on the sea bottom)

Station SV -18 (Depth 420 m)

Fig. 1. 10 min. The shrimp seen in this picture was first appeared at 5 minutes after landing.

Fig. 2. 25 min. A brittle star was pictured.

Fig. 3. 1 hr. 5 min. Shrimps gathering around the bait.

Fig. 4. 1 hr. 24 min. A young *Nautilus* clinging to the shrimps gathering around the bait.

Fig. 5. 1 hr. 34 min.

Fig. 6. 2 hr. 4 min. A crab was pictured.

Station SV -20 (Depth about 337 m)

Fig. 7. 17 min. First appearance of fish (a beard fish).

Fig. 8. 21 min. A big fish stole the whole body of bait fish.


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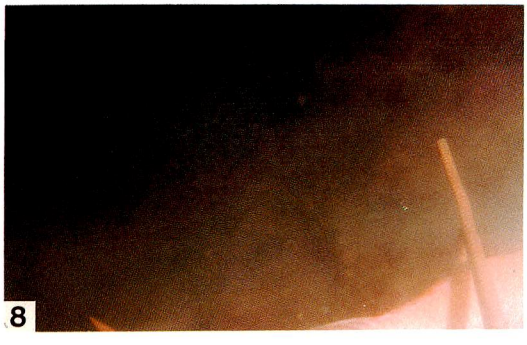
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Explanation of Plate 5

(Times of pictures described are all after landing of the frame for underwater still camera on the sea bottom)

Station SV -20 (continued)

Fig. 1. 41 min. A flower job fish and a kind of shrimp.

Fig. 2. 54 min. A yellow striped goat fish.

Fig. 3. 1 hr. 1 min. A flower job fish and a yellow striped goat fish.

Fig. 4. 1 hr. 11 min. A beard fish, a yellow striped goat fish and a flower job fish.

Station SV -22 (Depth 420 m)

Fig. 5. 17 min. A beard fish. The first appearance of fish (beard fish) at this station was at 5 minutes after landing.

Fig. 6. 27 min. Cloud of bottom mud stirred up by feeding motion of fish.

Fig. 7. 32 min. A rubby snapper is eating the bait. A large part of the bait is disappeared.

Fig. 8. 47 min. First appearacne of *Nautilus*.


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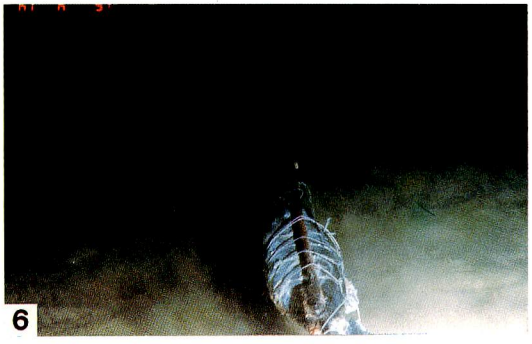
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Explanation of Plate 6

(Times of pictures described are all after landing of the frame for underwater still camera on the sea bottom)

Station SV -22 (continued)

Fig. 1. 1 hr. 22 min. A *Nautilus* clinging to the bait.

Fig. 2. 1 hr. 27 min. A *Nautilus*, a shark (*Centrophorus* sp.) and a shrimp are pictured.

Fig. 3. 1 hr. 32 min.

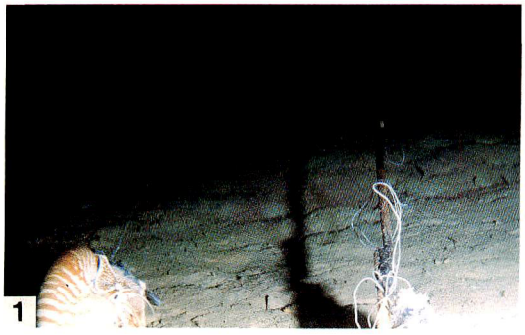
Fig. 4. 1 hr. 37 min.

Fig. 5. 1 hr. 41 min. A shark (*Centrophorus* sp.) is attacking bait or *Nautilus*.

Fig. 6. 1 hr. 51 min. Rubby snappers and a shark (*Centrophorus* sp.)

Fig. 7. 1 hr. 56 min. *Centrophorus* sp.

Fig. 8. 2 hr. 31 min. Beard fishes. The last picture of this station.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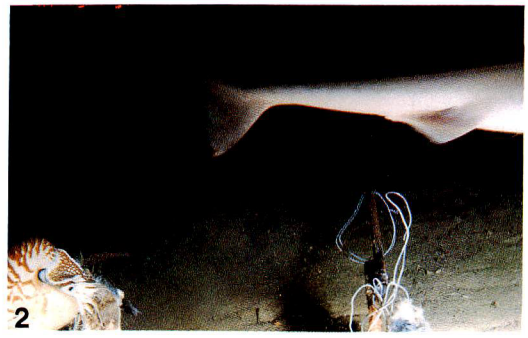
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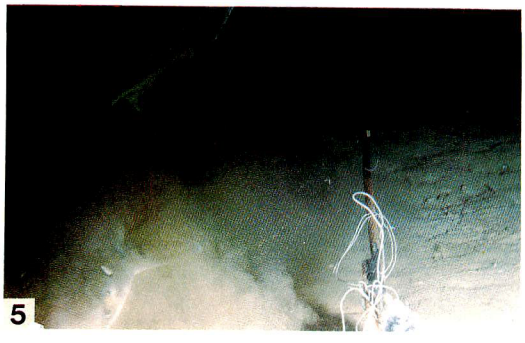
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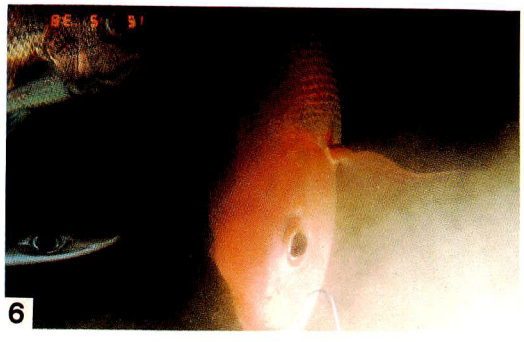
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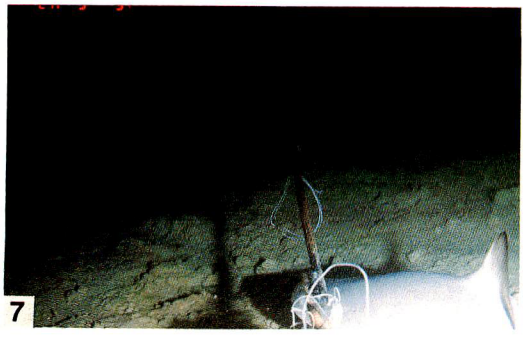
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