

AN AMPHIPOD, (*PARATHEMISTO GAUDICHAUDII*) AS A FOOD OF THE ANTARCTIC SEI WHALE

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An Antarctic amphipod, *Parathemisto gaudichaudii* (Guér.) is extremely abundant in the circumpolar belt around the Antarctic convergence (Baker, 1954; Kane, 1966). It forms a considerable part of the food of sei whales in the Antarctic as well as in the waters between the Antarctic and subantarctic convergence (Nemoto, 1959; 1962).

All materials treated here have been collected mainly from the stomach content of sei whales caught by Japanese whaling expeditions from 1964 to 1967 in the Antarctic. Some other specimens collected from plankton tows carried in 1957 and the stomach content of baleen whales were also examined.

These data on the food of sei whales reveal the distribution of *P. gaudichaudii* which is very important as the food of sei whales, and covers the lower subantarctic waters. A short discussion on the feeding habit of this species is also given.

FOOD OF SEI WHALES

P. gaudichaudii was reported as the food of sei whales in the Antarctic waters by Nemoto (1959), and its occurrence has been summarized in recent works (Nemoto, 1962; Doi, Ohsumi, and Nemoto, 1967).

The occurrence of *P. gaudichaudii* as the food of sei whales (*Balaenoptera borealis*) is shown in Table 1 and 2, in which the amphipod forms a considerable part of the food. The occurrence of this amphipod as the whale's food in recent years is evidently due to the shift of the whaling ground from the higher Antarctic waters to the comparatively lower latitudes of the Antarctic and northern waters of the Antarctic convergence.

The catch of sei whales in 1964–1965 season was concentrated somewhat in the waters south of the Antarctic convergence, but the main catch of sei whales in 1965–1966 was obtained from the northern waters of the convergence. This may be due to the fact that the copepods and amphipods form a major part of the food species, although there may be some misidentification of food species. In 1964 most of the occurrence of *P. gaudichaudii* was observed along the Antarctic convergence (Figs. 1 and 2).

DISTRIBUTION OF *P. GAUDICHAUDII*

P. gaudichaudii is an oceanic swarming species of the *Amphipoda-Hyperiidea* and is found mainly in surface waters (Kane, 1966). This species has been described not only in plankton collections, but also in many fish stomachs (Hurley, 1959). The

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southern limit of this species has been discussed by various authors (Bowman, 1960; Hurley, 1961; Kane, 1966). It is suggested that it might occur south of the Antarctic convergence or divergence (Barnard, 1930). Bary (1959) also described the occurrence of *P. gaudichaudii* in the south of subtropical convergence according to temperature-salinity and plankton diagram. Hurley (1961) and Kane (1966) considered further that *P. gaudichaudii* is the species distributing in warm water north of or in the subtropical convergence region, in the oceanic cold water south of the subtropical convergence region and colder water south of the Antarctic divergence.

TABLE 1. STOMACH CONTENTS OF SEI WHALES CAUGHT BY TWO JAPANESE WHALING EXPEDITIONS IN THE SOUTHERN OCEAN IN RECENT YEARS

	1964-'65 season	1965-'66 season
None	5356	7152
Copepods	23	2180
Euphausiids	3693	774
Decapods	6	65
Squids	0	5
Fish	16	2
Amphipods	111	1138
Total	9205	11316

TABLE 2. STOMACH CONTENTS OF SEI WHALES CAUGHT BY JAPANESE WHALING EXPEDITIONS IN THE SOUTHERN OCEAN IN 1966/1967 SEASON

Food Species	Quantity*				
	o	r	rr	rrr	R
None	1130	—	—	—	—
Copepods	—	308	190	73	44
Euphausiids	—	24	16	3	7
Amphipods	—	43	17	18	21
Amphipods and Copepods	—	4	4	3	2

* R: Much, rrr: More than half, rr: less than half, r: little.

In the north hemisphere, the records of *P. gaudichaudii* was only from the Atlantic, but has not been recorded in the North Pacific (Dunbar, 1954; Kane, 1966), and this would be one problem to be solved in the future investigation.

FEEDING HABIT OF *P. GAUDICHAUDII*

Three forms of the species *P. gaudichaudii* have been considered by recent investigations (Hurley, 1959), however, most of the observed specimens are f. *thomsoni* or "long-legged" form, which is referred to as f. *bispinosa* (Kane, 1966).

The observation of feeding habit in living specimens shows that the third peraeopod acts very quickly to seize zooplanktons, the action ranges of each peraeopod are

schematically in Fig. 3, as semi-circle. The fourth and fifth peraeopods also play some part in the action, but their spines and setae along the inner edge of the legs are not so well-developed as third peraeopod. The third peraeopod has well-developed seizing setae and spines (Plate I-1), the wide range of the reach is effective for the active zooplanktons. The first and second peraeopods have well-developed sickle-shaped terminal segments and they are considered to hold the caught prey

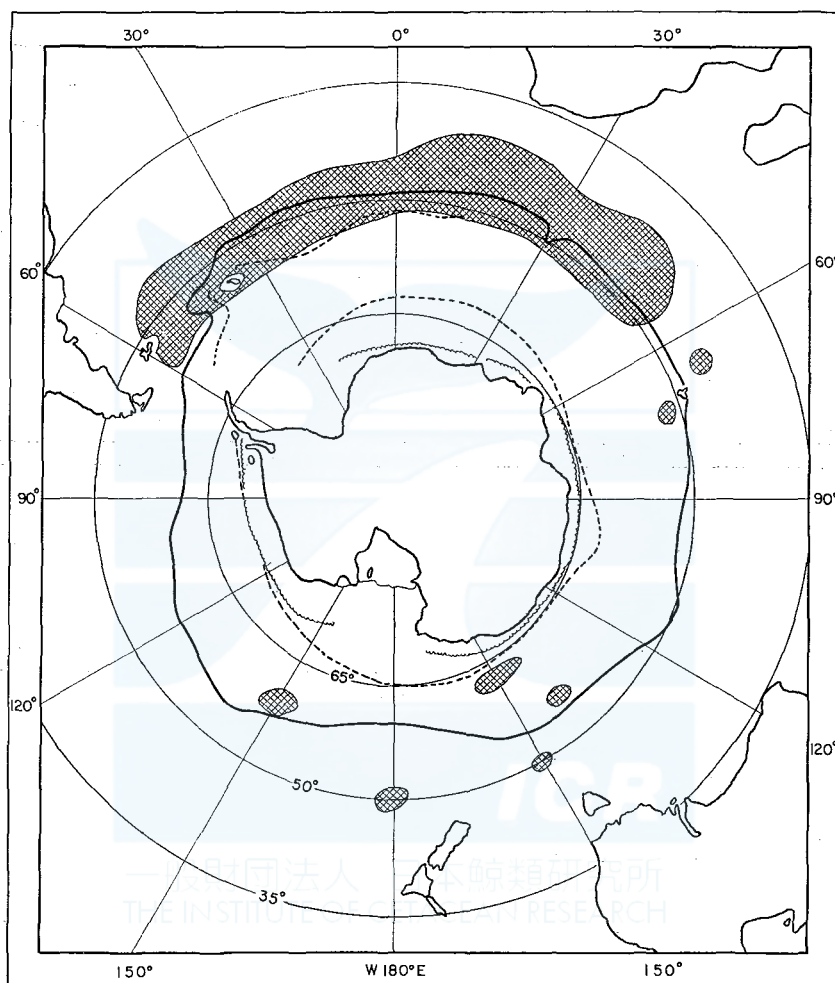


Fig. 1. Distribution of amphipods as the food of sei whales in the southern hemisphere.

and carry it to the mouth-part. The chellae in the terminal segment of the second gnathopod may tear the prey and carry to the mouthpart. The chellae in gnathopods confirm it. In addition to the feeding action, the sixth peraeopod keeps the body in right position in their swimming and feeding. The feeding habit in *P. gaudichaudii* is very similar to that described for *P. gracilipes* by Kane (1963)

who says "The posterior peraeopods were used to grasp and hold the prey and the first two peraeopods to hold it in place and direct the part to be eaten towards the gnathopods. These in turn seemed to be tearing off pieces which were pushed towards the continuously active mouthparts".

The mandible of *P. gaudichaudii* is typical carnivorous one. It completely lacks the pars molaris of the same type of euphausiids which is very effective in crushing hard shells like diatom.

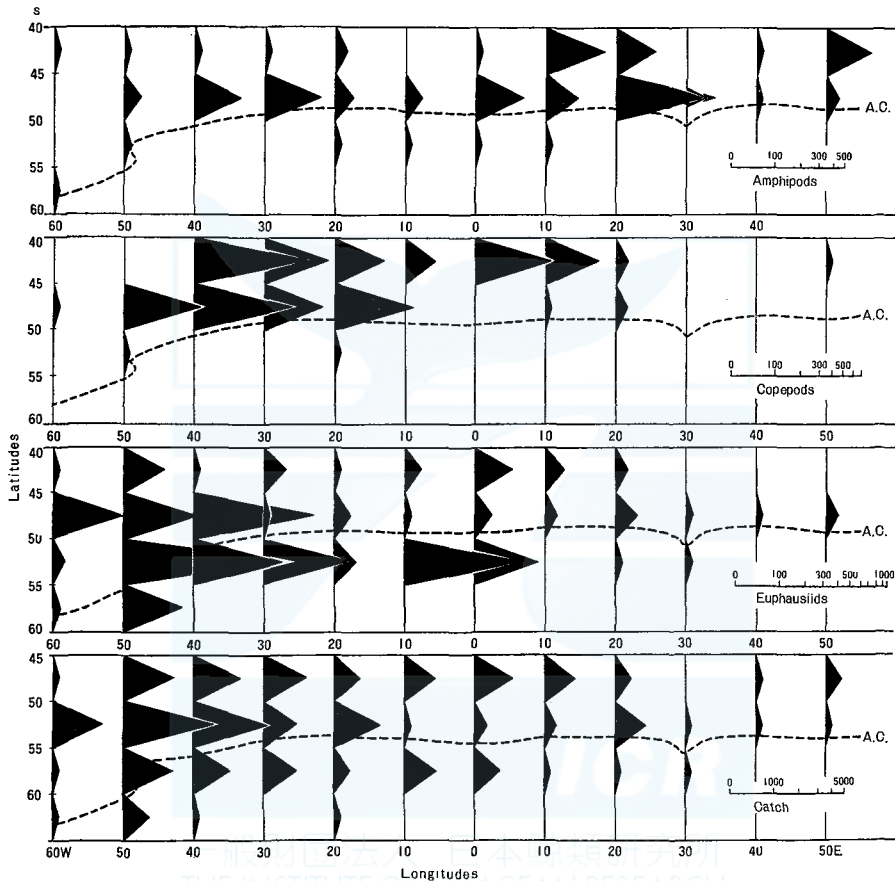


Fig. 2. Occurrence of food plankton in the stomach of sei whales in the Antarctic in 1964-65 and 1965-66 seasons.

The stomach also lacks the inner spines and mill-like cluster spines (Plate I-2) which are common in herbivorous euphausiid species such as *Euphausia superba* (Nemoto, 1967). The examination of stomach contents of *P. gaudichaudii* reveals that they mainly feed on zooplankton, especially copepod (Plate I-3, 4). In the stomach of large *P. gaudichaudii* three or more copepods of 3 mm in cephalothorax length were often observed (Plate I-3). In some cases, appendages of euphausiid were also found in its stomach (Plate I-5). Plate I-6 shows diatoms in the stomach

of young amphipod, and it suggests that the phytoplankton fragments are originated from the fed copepod or else, that the young *P. gaudichaudii* might take phytoplankton.

The specimens in the same patch were often found to have fed on equal quantity of copepod, suggesting that they came across the patch of copepod and took the patch all at once.

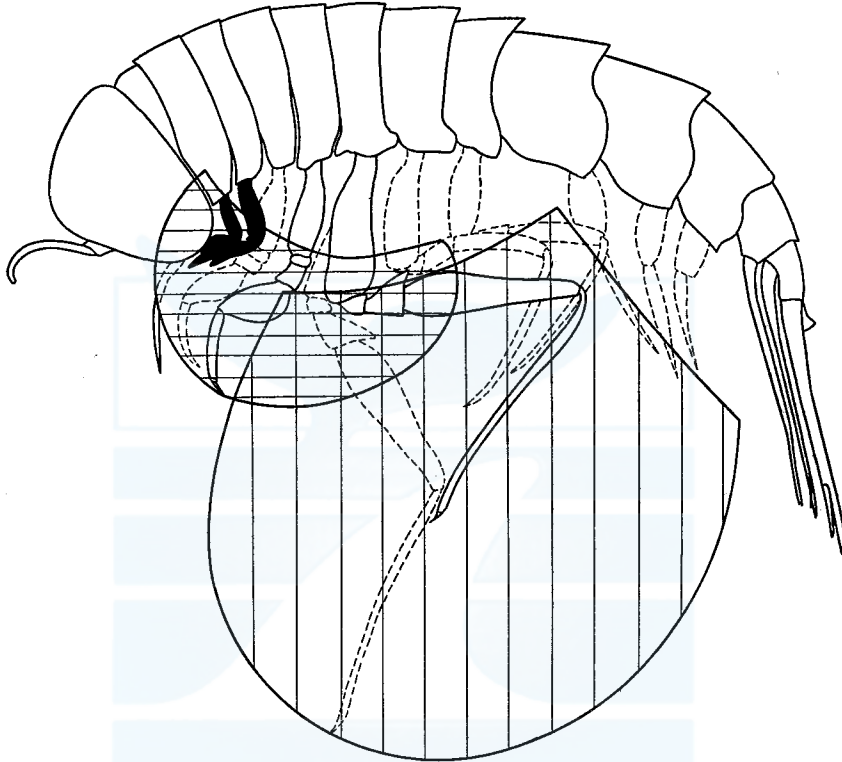


Fig. 3. Schematic illustration of movement of thoracic legs of *Parathemisto gaudichaudii* in feeding.

In conclusion it can be said that *P. gaudichaudii* is one of the typical voracious carnivorous zooplankton species, and it constitutes a considerable part of sei whale's food in the Antarctic. Sei whales feed also on carnivorous zooplankton, *P. gaudichaudii* in the southern hemisphere, and their feeding behavior is different from that of the other baleen whales such as blue and fin whales that feed on herbivorous euphausiid, *Euphausia superba* and *Euphausia vallentini*.

It is also suggested that *P. gaudichaudii* consists of another pathway in food chain as well as euphausiid groups in the southern hemisphere (Nemoto, 1966), while correlations in food web are present as following series: Phytoplankton—small-sized zooplankton, Copepod—carnivorous Amphipod, *P. gaudichaudii*—Sei whales. This chain is the typical one which is related to the carnivorous zooplankton in the open ocean.

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EXPLANATION OF PLATE

- 1—Seizing spines in third pereopod. 2—Stomach wall of *Parathemisto gaudichaudii*. 3—Stomach contents of *P. gaudichaudii*. 4—Stomach contents of *P. gaudichaudii*. 5—Stomach contents of *P. gaudichaudii*. 6—Stomach contents of *P. gaudichaudii*.

