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Further Notes on Ovarian Histology of the Stejneger's Beaked Whale, *Mesoplodon stejnegeri*, from a Recent Stranding on the Coast of Niigata District, Sea of Japan

By

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Abstract A pair of ovaries of a Stejneger's beaked whale, *Mesoplodon stejnegeri*, were studied histologically. The animal was 4.8 m in total length, stranded on the coast of Noh Town, Niigata Prefecture, facing the Sea of Japan, in late February 1993. The ovaries were 42 and 37 mm in length and 6.7 and 3.3 g in weight, respectively. After removal from the decomposing body, the ovaries were initially preserved in 10% formalin solution. Subsequently, after 15 months, they were postfixed in Bouin's solution. Light microscopy revealed several tens of primary follicles in the connective tissue stroma of the cortical region, in contrast to the conditions in previously described specimens. Well-developed corpora albicantia were present throughout, whereas neither a well-defined corpus luteum nor characteristically coiled and thick-walled arteries were detected in any of the blocks examined.

As was reported previously (HONMA, 1994), the first histological observations on Stejneger's beaked whale were made using materials taken from two individuals stranded near Niigata City in early March 1992. Surprisingly, those materials failed to show any follicle, typical corpus luteum or typical corpus albicans in the cortex, although the existence of well-developed, coiled arteries in the medulla was noted. Accordingly, such histological pictures were thought to be suggestive of postreproductive ovaries of spent, senile whales, corresponding to those of postmenopausal human ovaries, as was mentioned by MARSH and KASUYA (1984). Therefore, for increased understanding of the reproductive cycle of Stejneger's beaked whales, which are considered to be some of the rarer whales in the world (MEAD, 1989), further histological examination of ovaries, when available, should be made.

The present paper, being a further light microscopic study of the Stejneg-

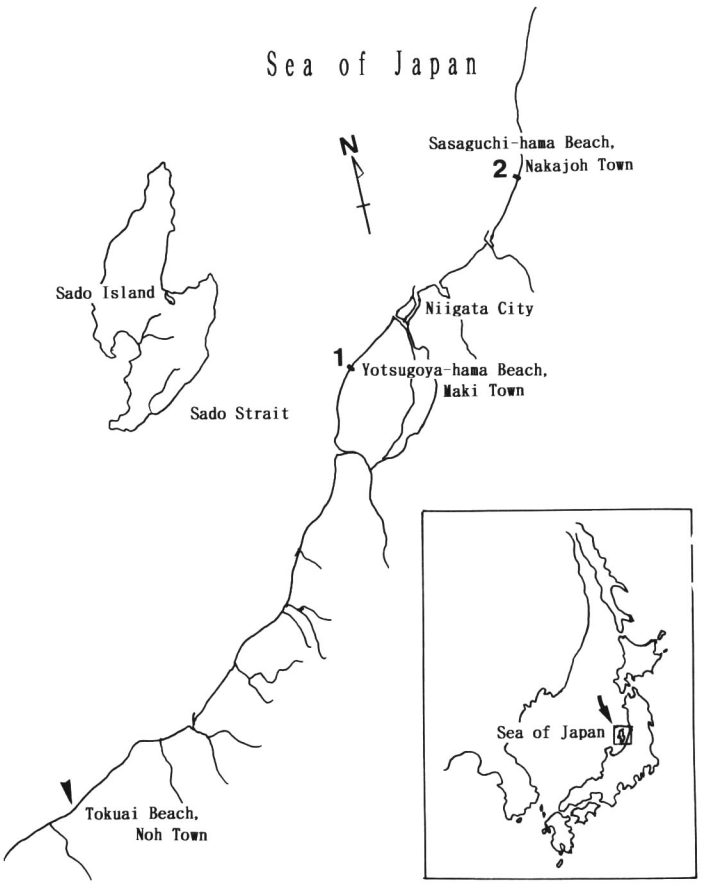

Fig. 1. Map of Niigata Prefecture, Sea of Japan, showing the stranding site (arrowhead) of a Stejneger's beaked whale, *Mesoplodon stejnegeri*, and other reported stranding localities (HONMA, 1994): 1 and 2.

er's beaked whale ovaries, is based on another individual stranded on the coast of Niigata Prefecture.

Material and Methods

The study was based on a Stejneger's beaked whale, *Mesoplodon stejnegeri* TRUE, 4.8 m in total length, stranded on Tokuai Beach, Noh Town, Niigata Prefecture, several days before 3, March, 1993 (Fig. 1.) (HONMA, 1994). Although the specimen was in a somewhat deterionated condition when discovered by a villager, the visceral organs were removed in their entirety and preserved in 10% formalin, being deposited in the National Science Museum, Tokyo by the junior author. Fifteen months later, a pair of ovaries were made

available to the senior author. At that time, the ovaries, grayish-buff or bronze in color, were sectioned sagittally and refixed in Bouin's solution. Their sizes and weights are shown in Table 1.

Four blocks taken from each ovary were subsequently dehydrated through a graded alcohol series, embedded in paraplast, and cut serially at 8 μm thickness. The sections were stained with Mayer's hematoxylin-eosin double staining and Heidenhain's azan trichrome, and examined under a light microscope.

Table 1. Measurements of the ovaries from a Stejneger's beaked whale, *Mesoplodon stejnegeri*, stranded on the coast of Noh Town, Niigata Prefecture, in late February, 1993.

	Size (mm)	Weight (g)
Specimen I (left lobe)	42×25×11	6.7
Specimen II (right lobe)	37×20×10	3.3

Observations

Macroscopy

The left ovary which is larger, thereafter referred to as specimen I (Sp.I), had a prominent, white protuberance, navel-like in shape, with a shallow crater on the outer portion. Although several deep furrows were present, the

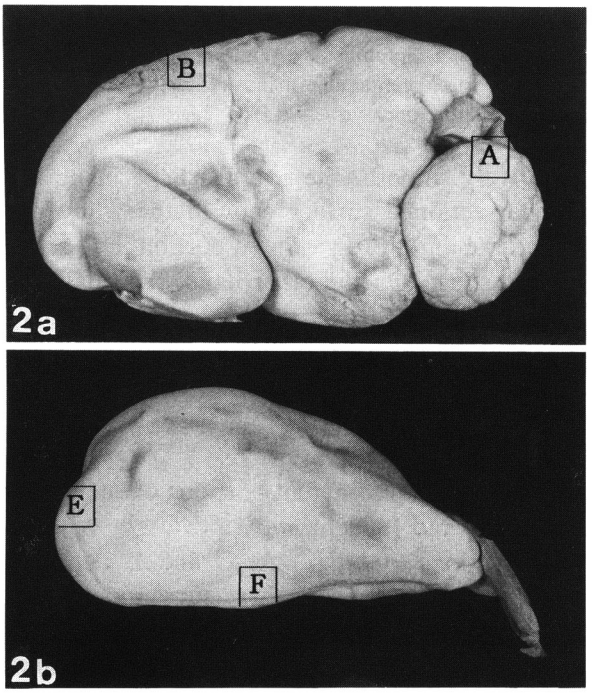

Fig. 2. Macroscopic appearance of ovaries. a, Specimen I (left lobe) bearing a protuberance with a crater suggestive of recently ruptured follicle; b, Specimen II (right lobe) with a smooth surface. Positions of the blocks for microscopy are indicated by alphabets. ×2

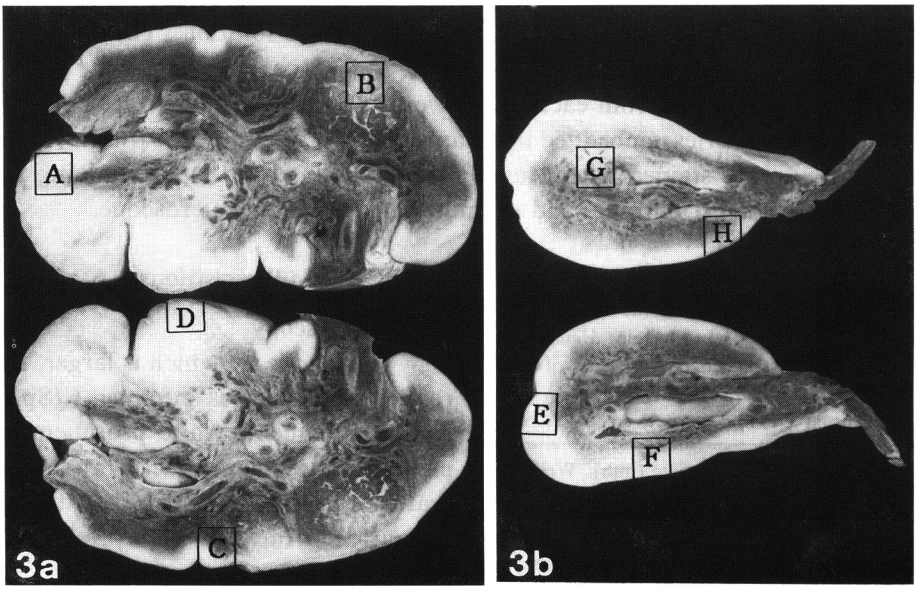

Fig. 3. Sagittal sections of the ovaries. As in Fig. 2, positions of the blocks for microscopy are indicated by alphabets. a, Specimen I – White portion is occupied with the corpora albicantia, and dark portion containing many vessels; b, Specimen II – Medullary portion penetrated by a large, thick vessel. ×1.7

surface was comparatively smooth, the overall shape being kidney-like (reniform) (Fig. 2a). The sectioned surface showed the white portion to be the corpora albicantia, and the dark, brown tinted portion in the medulla to include many blood vessels (Fig. 3a). On the other hand, the smaller right ovary (Sp. II), somewhat spatulate in form, was smooth on the surface, except in the medullary portion, which was penetrated by a thick dark brown-tinted vessel (Figs. 2b, 3b).

Microscopy

Four blocks were taken from different portions of each ovary: A, B, C and D from Sp. I, and E, F, G and H from Sp. II.

The microscopic sections of blocks A, C and E contained parts of the corpora albicantia (Fig. 4). Each corpus was surrounded by a single layer of germinal epithelium, *i.e.*, the mesothelium, consisting of cubic cells. Almost all tissues of the corpus albicans included a large amount of fibrous material, of collagenous and hyaline nature, stained moderately with aniline blue. Connective tissue septa, which stained deeply with aniline blue, ran freely, supporting a heavily convoluted cord of fibrous tissue in papillomatous condition (Fig. 5). The margin of the corpus albicans was surrounded by the ovarian stroma (Fig.

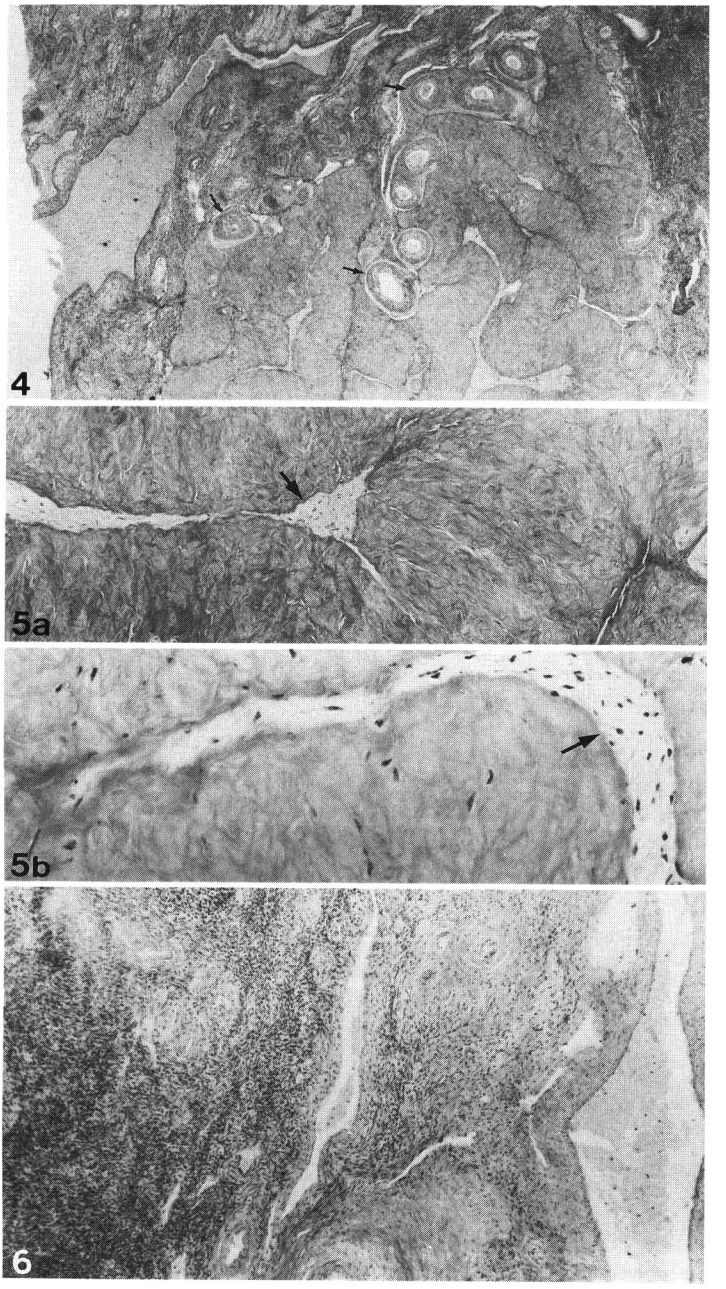

Fig. 4. Low power view of a part of corpus albicans. Note large amount of collagenous connective tissues and thick-walled arteries (arrows). Azan stain. ×100

Figs. 5a, b. Enlarged view of a part of corpus albicans showing numerous connective tissue cords and invaded ovarian stroma (arrow). Azan stain. a, ×400; b, ×1000

Fig. 6. A large mass of the interstitial cells in the medullary zone. Azan stain. ×400

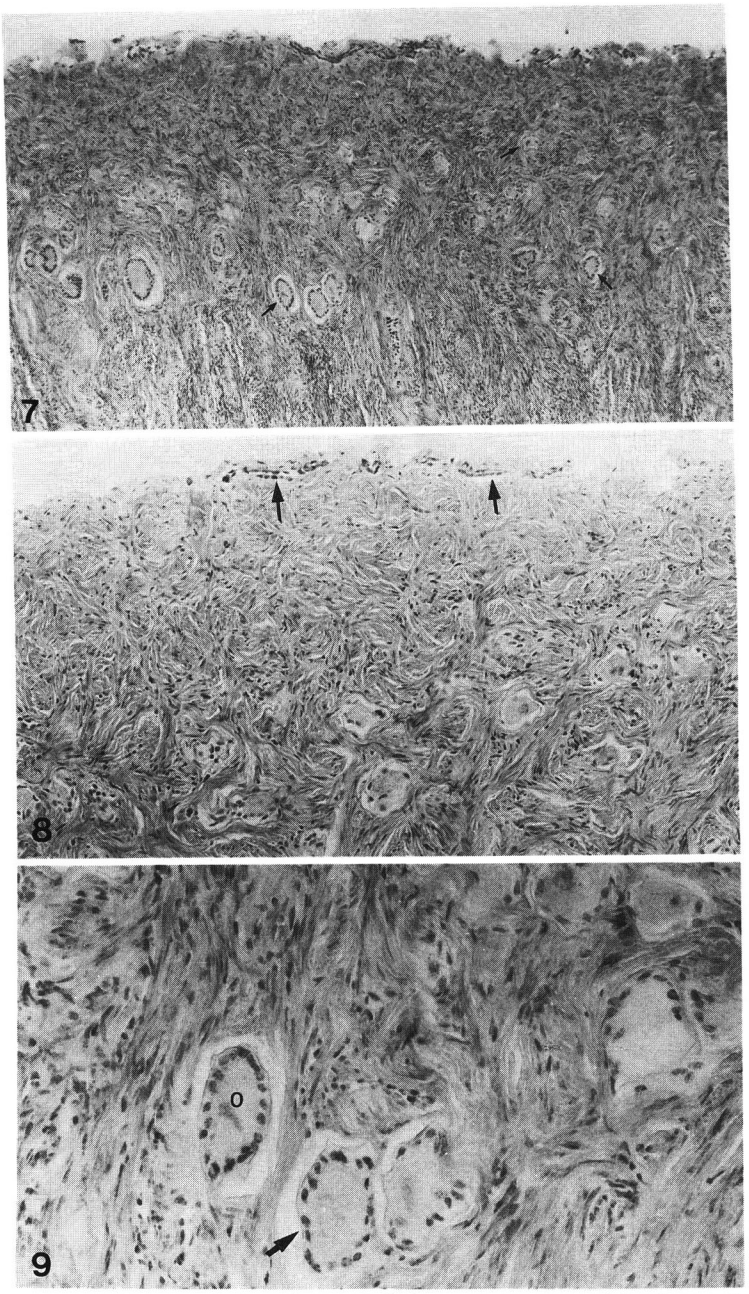

Fig. 7. Low power view of the primary follicles (arrows) located in the cortical region. Azan stain. ×400

Fig. 8. As in Fig. 7, showing a few, simple exocrine glands (arrows) in the tunica albuginea. Azan stain. ×600

Fig. 9. Enlarged view of the primary follicles consisting of outer granulosa cells (arrow) and inner ooplasm (O). Azan stain. ×1000

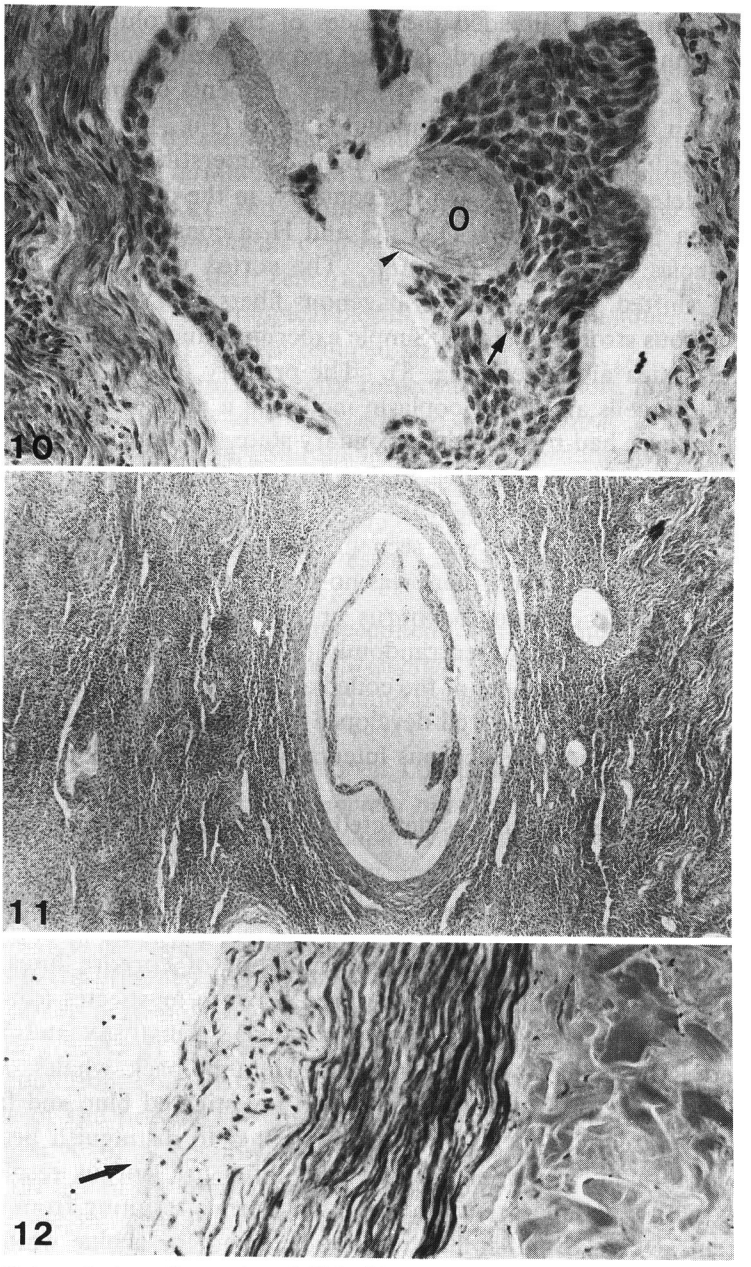

Fig. 10. Enlarged view of secondary follicle. Note translucent zona pellucida (arrow head) surrounding the ooplasm (O) and the zonation of granulosa cells (arrow). Azan stain. ×1000

Fig. 11. Low power view of a degenerated follicle in the stroma. Azan stain. ×400

Fig. 12. Enlarged view of an arterial segment showing a well-developed intima (arrow). Azan stain. ×1000

4), some of which had invaded the spaces of the convoluted cord (Fig. 5). Numerous connective tissue cords, stained red with azocarmine, were scattered throughout the fibrous tissue (Fig. 5). Many segments of thick-walled arteries were located in the spaces of the convoluted cords (Fig. 4).

In the medullary zone, a great amount of interstitial cells of acidophilic nature were detected (Fig. 6). On the contrary, in the dense cortical tissues of fibrous stroma found in the B, D, F, G and H, a considerable number of the primary follicles were found (Fig. 7). The cortex was constructed from a superficially shifted, thin layer of collagenous fibers, *i.e.*, the tunica albuginea, and dense fibrous stroma (Fig. 7). Simple exocrine glands were located sporadically in the tunica albuginea (Fig. 8). The primary follicle was composed of outer granulosa cells and inner ooplasm including a nucleus (Fig. 9). A small number of follicles had reached the secondary state, the ooplasm being surrounded by a translucent zona pellucida, and an increase in the number and layers of granulosa cells was noticed (Fig. 10).

Occasionally, an antrum was seen in the space of the granulosa of some secondary follicles. However, there was no sign of a developed Graafian follicle accompanied a thick cumulus oophorus or corona radiata. Degenerated and regressive follicles were scattered randomly (Fig. 11).

Although the development of the coiled arteries was very poor, in the cavity of one large thick artery, a well-developed intima was recognized (Fig. 12). Curiously, however, neither a corpus luteum nor lutein cells could be found in any of the blocks.

No primordial germ cell was detected in all the sections observed.

Discussion

Regarding the degree of protrusion and tint of corpora lutea, SLIJPER (1966) pointed out that differences occurred between mysticetes (pinkish, protruded) and odontocetes (yellow, not protruded). DEMPSEY and WISLOCKI (1941) and ROBINS (1954), who investigated hump-back whales, *Megaptera novaeangliae*, and VAN LENNEP (1950), who investigated blue and fin whales, *Balaenopiera musculus* and *B. physalus*, attempted to distinguish between two types of corpora lutea and/or corpora albicantia: *i.e.*, corpus resulting from pregnancy, with a gel-filled central cavity, and corpus resulting from ovulation, without central cavity. A similar result was found for a blue white dolphin, *Stenella coeruleoalba* (HIROSE *et al.*, 1970) and white whale, *Delphinapterus leucas* (SERGEANT, 1973). IVASHIN (1984), who reviewed the works referring two types of corpora lutea in cetaceans by Russian specialists, mentioned and illustrated two distinguishable corpora albicantia resulting from pregnancy and ovulation (see also FISHER & HARRISON, 1970; COLLET & HARRISON, 1981).

On the contrary, MARSH and KASUYA (1984), who conducted a detailed study on ovarian changes in the short-finned pilot whale, *Globicephala macrorhynchus*, considered it impossible to separate corpora albicantia of pregnancy from those of ovulation. The same interpretation was stated by PERRIN and DONOVAN (1984), and the terminology of ovarian histology recommended by them were adopted by COLLET and ROBINEAU (1988). Following MARSH and KASUYA (1984), the *Mesoplodon* ovaries examined here may correspond to the regressive stage, owing to their remarkably reduced size and weight, and atrophied corpora albicantia. Histological pictures of the corpora albicantia were also suggestive of an old- and a fairly reduced state.

Considering gross histology, with respect to the corpora lutea and corpora albicantia, of the minke whale, *Balaenoptera acutorostrata*, LOCKYER (1987) showed the diameter of the largest follicles to be in accordance with reproductive phases. Nevertheless, not all the corpora albicantia derived from the corpora lutea did not disappear during the life span of the whales (SLIJPER, 1966; MARSH & KASUYA, 1984; and others), the present examination revealed a very similar phenomenon.

It is noteworthy that the present specimens contained many primary follicles that were not detected in the previous *Mesoplodon* specimens. The previous ones were characterized by numerous, coiled and thick-walled arteries and a considerable number of lutein cells (HONMA, 1994). JACOBSEN (1941) described both primary follicles, more highly developed Graafian follicles and corpora lutea graviditatis in the blue whale, *Balaenoptera musculus*.

Regarding the weight of *Mesoplodon* ovaries, MEAD (1989) documented 11–12 g at the onset of sexual maturity, and mean weight of ovary of sexual mature females is 13–15 g. Moreover, the maximum recorded weight of a single ovary was 49 g in *Mesoplodon mirus*. On the other hand, the combined weight of the ovaries in the present specimen was 10.0 g (6.7 g + 3.3 g), the value being less than half of the previous two specimens reported, 24.5 g (11.6 g + 12.9 g) and 21.2 g (10.7 g + 10.5 g) (HONMA, 1994). On the basis of their regressive and shrunken condition, both macro- and microscopic (MARSH & KASUYA, 1984), the ovaries of the present specimen may be categorized as post-reproductive, being suggestive of a possibly spent state. However, it was impossible to determine the age of the present stranded specimen. With regard to histological criterion of the *Mesoplodon* ovaries, it is needed further individuals representing different seasons and growing stages.

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