TAXONOMICAL CONSIDERATION ON GENERA OF *DELPHINIDAE**

MASAHARU NISHIWAKI

INTRODUCTION

There are some difference in the considerations regarding separation and the combination of the various genera of *Delphinidae* according to different authors. According to the checklists by J.E. Gray, he separated them into three families *Balaenidae*, *Catodontidae* and *Delphinidae*, in the suborder *Cete* in 1850, but he corrected it to six families, *Catodontidae*, *Ziphiidae*, *Platanistidae*, *Iniidae*, *Delphinidae* and *Globicephalidae*, in the section *Denticeti* in 1866. Some of the previous authors after Gray have written on separation into families other than already established. The separation considered differ according to the individual author however the reasons given by each are most reasonable, as for instance, some of the previous authors have separated them into *Kogiidae*, *Phocaenidae* and *Monodontidae* (*Delphinapteridae*) as well as *Physeteridae*, *Ziphiidae*, *Platanistidae* and *Delphinidae*. There is very clear reason for these separations, and the author could think it reasonable. None of them however, separated the *Globicephalidae* from the *Delphinidae* in the suborder *Odontoceti*. If a genus of a family has some different characters from another genera of the family, it may be recognized as a subfamily or an individual family. The author if possible does not wish to apply subfamily as a general principle. It is necessary to consider, of cause, the genera is derived from what kind of ancestral animals.

It is easy to understand that in the family *Physeteridae*, the subfamily *Kogiinae* was separated with the subfamily *Physeterinae*, and then the subfamily *Kogiinae* was made an independent family *Kogiidae*. The author would like to induce separations of the family *Delphinidae* as mentioned above.

The following names of the living genera were included in the family *Delphhiidae* by recent authors. *Delphinus*, *Stenella*, *Tursiops*; *Lagenorhynchus*, *Lissodelphis*, *Steno*, *Sotalia*, *Cephalorhynchus*, *Globicephala*, *Pseudorca*, *Feresa*, *Grampus*, *Grampidelphis* and *Orcaella*. These genera have one to ten species, so the family *Delphinidae* is the largest family in the suborder *Odontoceti*. The author already recognized that *Phocaena*; *Phocaenoides* and *Neomeris* were included in the family *Phoocaenidae* indepdendently from the family *Delphinidae*.

It is considered that there are apparently two types in the family *Delphinidae*. One has a pungent beak, numerous teeth and small in size, another has a beakless blunt head, few teeth and moderate in size. The various characters of these types must be studied.

Cephalorhynchus and *Sotalia* are considered in the first type, but the author has no detailed descriptions on these genera, so the author with much regret is unable

* Dedicated to Professor T. Ogawa for his sixtieth birthday

to discuss on these genera.

BODY LENGTH AND NUMBER OF VERTEBRAE

It was clear that the total number of vertebrae, including cervical, dorsal (thoracic), lumbar and caudal vertebrae, were different in each of the genera.

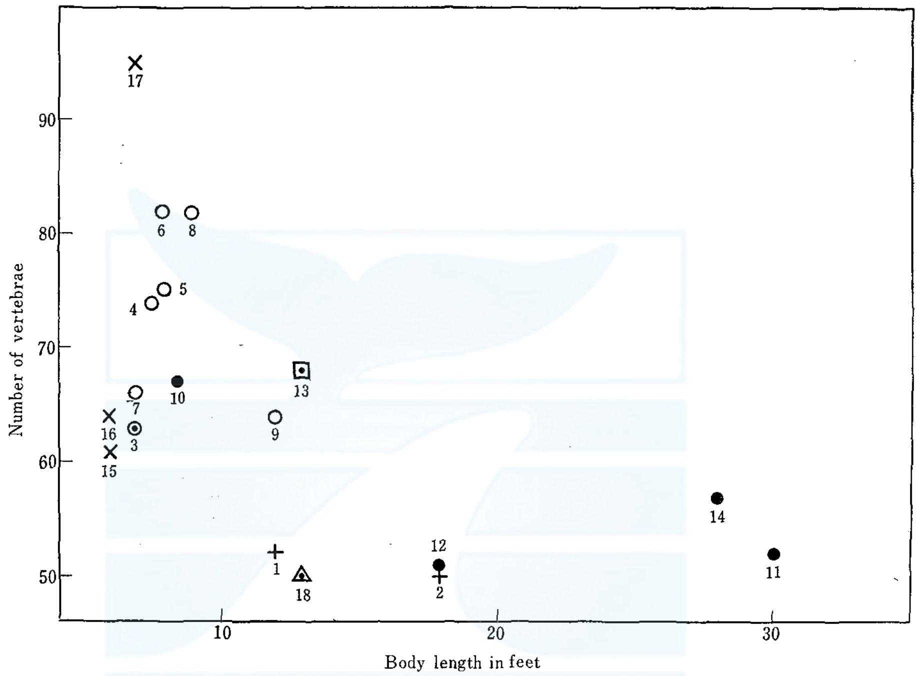

Fig. 1. Relation between body length and number of vertebrae in various genera of smaller toothed whales.

Explanation of the marks in the figures.

The marks O are the genera with only the *Atlas* fused to the *Axis*; the marks ● indicate those in witch the *Atlas* is fused with more than two other cervicals. The genus *Orcaella* is shown with the mark ⊙, and the mark ▣ shows the genus *Grampidelphis*. The marks × are the genera of the family *Phocaenidae*, and the marks + are the genera of the family *Monodontidae*. The mark △ shows the family *Kogiidae*. The attached number of marks represent the name of the genera. 1: *Monodon*, 2: *Delphinapterus*, 3: *Orcaella*, 4: *Delphinus*, 5: *Stenella*, 6: *Lissodelphis*, 7: *Steno*, 8: *Lagenorhynchus*, 9: *Tursiops*, 10: *Feresa*, 11: *Grampus*, 12: *Pseudorca*, 13: *Globicephala*, 14: *Glampidelphis*, 15: *Neomeris*, 16: *Phocoena*, 17: *Phocaenoides* and 18: *Kogia*.

Fig. 1 shows that the total number of vertebrae, whether small or large, does not affect the body length. The average of a number of species of each genera are given in the figure, but as for the body length, the measurements of full grown male have been given. Usually male is bigger than female in the suborder *Odontoceti*. According to this figure, the large sized genera have smaller number of vertebrae, as compared with the larger number of vertebrae in the smaller sized genera. This suggests that each vertebral bone is bigger in the large sized genera.

These figures (Fig. 1–Fig. 3) also show the positions of the genera of the families *Kogiidae*, *Monodontidae* and *Phcaenidae* which are already separated from the family *Delphinidae* by the previous authors.

FUSED BONES IN CERVICAL VERTEBRAE

The very important character is which of the seven cervical vertebrae are fused. (As it is well known, there is no genus which has six or eight cervical vertebrae in the order Cetacea.)

In the family *Physeteridae*, the *Atlas* is free, but the *Axis* to the seventh cervical are all fused, but the all cervicals are fused in the case of the family *Kogiidae*. The family *Ziphiidae* has fused cervicals, from the *Atlas* to the *Axis* or to the fourth. All free cervical vertebrae are observed in the case of the family *Monodontidae* and the *Platanistidae*.

In the case of the genera in the family *Delphinidae*, it is described that at least the first and the second cervical vertebrae are fused together. Some authors mention that " at least two bones are fused " but the author on examining this character have found the following facts.

The names of the genera with only the *Atlas* and the *Axis* fused, are *Delphinus*, *Stenella*, *Lagenorhinchus*, *Tursiops*, *Lissodelphis*, *Steno* and *Orcaella* (*Cephalorhynchus* and *Sotalia* were not studied). The author observed, however, in this genera especially in the *Stenella* or the *Delphinus*, the third cervical became fused with the *Axis* after growth. It seems that these cases have not occurred due to the hereditary nature, but to the ageal changes. These seven genera are small in size and have a pungent beak, except the genus *Orcaella*.

The genus *Orcaella* (Irawaddy dolphin) has a beakless blunt head, moderate number of teeth (15–17/12–14) and small in size. They are very different in character from both types of the Delphinidae. Furthermore the *Orcaella* is generally fluviatile and comparatively restricted in distribution. The author would first like to separate this genus *Orcaella* from the family *Delphinidae*.

Another genera in the family *Delphinidae* have not only the *Atlas* and the *Axis* fused but also the third or more cervical vertebrae fused to the *Atlas*. In the case of the genus *Feresa*, the *Atlas* to the third cervicals are fused, and in the genus *Grampus* the cervicals are fused from the *Atlas* to the fourth. The genera in which the *Atlas* is fused to the sixth cervical vertebrae are the *Globicephala*, *Pseudorca* and *Grampidelphis*. These five genera have a beakless blunt head, fewer number of teeth (under fifteen in a tooth row) and some of them reach moderate in size.

SHAPE OF SKULL

The characteristics of the skull are very important, and a most intricate method of measurement is employed, however it would be too complicated to explain the method here, therefore, in this paper only the length of the skull and the length of the rostrum will be treated as the ratio of their breadth. The length of the skull is the straight length from the middle of the occipital conuyles to the tip of the snout when the skull is situated horizontally. By the breadth of the skull, the greatest width of the skull is meant and this is usually equal to the breadth across the middle of the orbits. The length of the rostrum is obtained by measuring the base, and this is almost equal to the length between antorbital notches.

Fig. 2 shows the relation between the length/breadth ratio of the skull and the length/breadth ratio of the rostrum. In the figure the plotted points are arranged from underleft to upperright. The open circles are the genera in which are *Atlas*

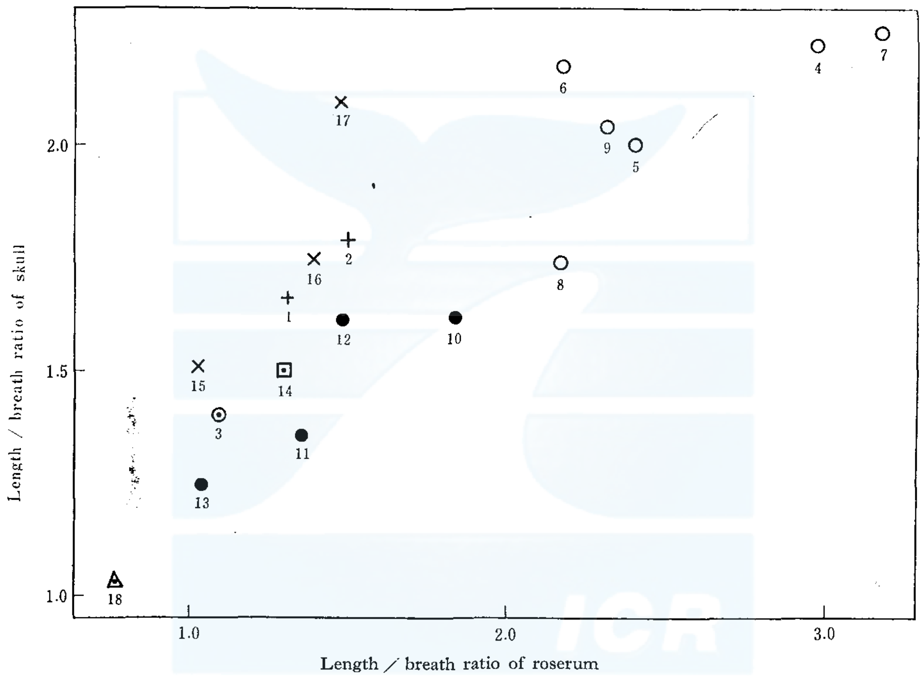

Fig. 2. Relation between skull and snout on their slenderness in various genera of smaller toothed whales.

only is fused to the *Axis*, and the closed circles indicated those in which the *Atlas* is fused more than three cervicals. There is one exception however and that is the genus *Orcaella* shown with an open circle with a point. It is clearly separated into two groups, the open circle group is the *Delphinus* type which have long slender rostrum (over twice the breadth in length), and the closed circle group is the *Globicephala* type which have short broad rostrum (1.5 times of breadth or less in length). The long skull length of the *Delphinus* type group is mainly due to its rostrum length, but in the *Globicephala* type group the brain case is wider. In this figure the genus *Orcaella* occupies a special position near the genus *Neomeris* of the family *Phocaenidae*.

NUMBER OF MAXILLARY TEETH AND LENGTH OF ROSTRUM

It can be considered that the longer rostrum has more teeth than the shorter rostrum. Fig. 3 shows the relation between the number of maxillary teeth and the length/breadth ratio of the rostrum. In the figure the long rostrum generally has more teeth. The genus *Steno* has the longest ratio of the rostrum but surprisingly the number of teeth are relatively small (20–27 in each tooth row). This is caused by the following reason. The teeth size is relatively large and the rostrum is comparatively slender. In this figure also the open circled genera have formed a group (relatively widely diffused) and the closed circle genera have formed another group.

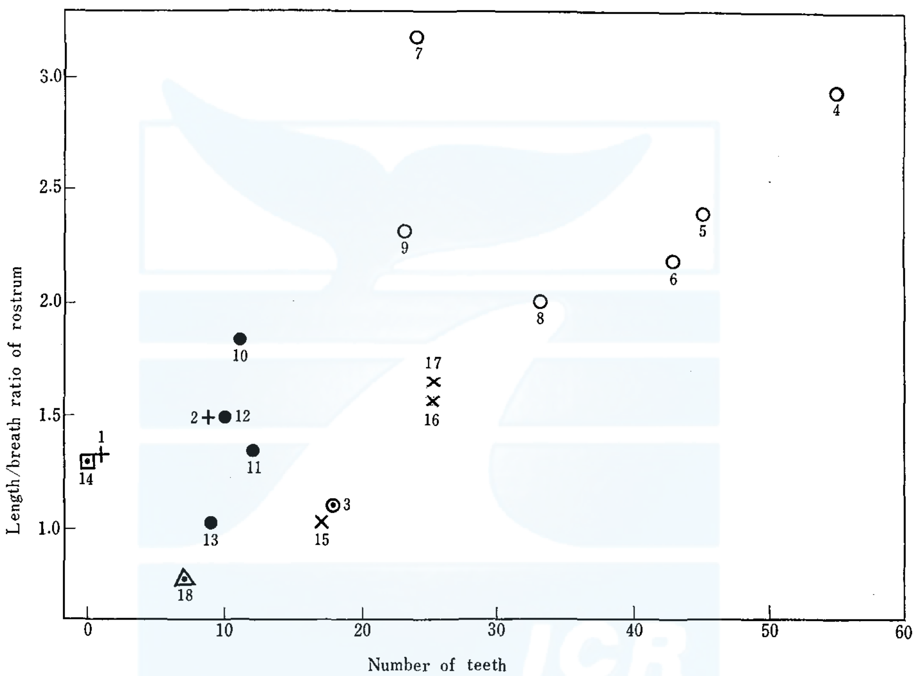

Fig. 3. Relation between number of teeth and length breadth ratio of snout in various genera of smaller toothed whales.

However the genus *Grampidelphis* has no maxillary teeth and does not belong to either of the groups. This may be a reason for separating it into an individual group.

The genera of the family *Monodontidae* and the *Phocaenidae* each form a different group. The genus *Orcaella* also occupies a special position near the genus *Neomeris*. In these two genera (*Orcaella* and *Neomeris*), the shape of the teeth are quite different, but no discussion on the matter will be taken up here.

It is possible to discriminate them into groups by elaborating on the relationship of the foregoing elements, however the author has refrained from illustrating them in figures, because it would be too difficult to explain their connection.

CONCLUSION

Some taxonomical considerations are made on the reasons already mentioned above.

In the fourteen genera of the family *Delphinidae*, the six genera are accepted as the *Delphinus* type, and the five genera are considered as the *Globicephala* type. The genus *Orcaella* is being separated from the two types. The author considers that the family *Phocaenidae* is already separated from the family *Delphinidae* by the previous authors. The *Delphinus* type genera generally have a long slender beak (over twice the breadth in length of rostrum), numerous teeth (over 20 teeth in each tooth row) and relatively small in size (under 13 feet). This type also has the cervical vertebrae with only the *Atlas* fused with the *Axis*. The genera of the *Delphinus* type are *Delphinus, Stenella, Lagenorhynchus, Tursiops, Lissodelphis* and *Steno* (*Sotalia* and *Cephalorhynchus* may be included in this type, but these two genera are excluded from this study because the available data was scanty). The author considers these genera should be included in the family *Delphinidae*.

The genus *Orcaella* should be separated from the family *Delphinidae* and independently form the new family *Orcaellidae*.

The *Globicephala* type genera generally have a beakless blunt head (under 1.6 breadth in length of skull), fewer teeth (under 15 in each tooth row) and some of them reach moderate in size (over 25 feet). Furthermore the cervical vertebrae of this type are recognized as having the *Atlas* fused not only with the *Axis*, but also with the third or more cervicals. The genera of the *Globicephala* type are *Globicephala, Feresa, Pseudorca, Grampus* and *Grampidelphis*, and these genera should be separated from the family *Delphinidae*. The author would like to propose that the family *Globicephalidae* has come to the fore again and that these genera should belong to this family.

Though the morphological characters should be examined very carefully, differences which are too minor should not be considered in making. Neverthless the separation should be made with confidence, if the feature can be clearly differenciated. In the taxonomical consideration of animals, making too many species, genera or families may be indiscreet, but using subfamilies are not an adequate way also.

Each genus of the family *Globicephalidae* has its own special characters, but the most distinct feature in the majority of them is no teeth on the upper jaw. The genus which has this feature is the *Grampidelphis*. The author would like to venture to set up the new family *Globidelphinidae*.

As a conclusion, the author considers that the genera of the foregoing family *Delphinidae* should be separated into the *Delphinidae, Orcaellidae, Globicephalidae* and *Globidelphinidae* families.

The author in the following table shows a key to the living families of *Odontoceti* through his examination of the characters of the genera.

KEY TO THE LIVING FAMILIES OF *ODONTOCETI*

1_1 Tip of lower jaw ending an appreciable distance behind foremost part of head; blowhole far forward on head.

2_1 Head massive, 1/4 to 1/3 of body length; functional teeth large, 18 to 28 pairs in number, confined to lower jaw; dorsal fin an ill-defined lump; flipper rounded; size large (30 to 60 feet). *Physeteridae*

2_2 Head 1/6 of body length; functional teeth small, slender and curved, 9 to 16 pairs confined to lower jaw; dorsal fin well developed; flippers tapering; size small (9 to 13 feet). *Kogiidae*

1_2 Lower jaw extending at least as far as tip of snout; blowhole some distance from tip of snout.

3_1 Two conspicurous grooves forming a V-shape on the surface of throat blubber; dorsal fin present, considerably behind middle of body; no notch in middle of hinder margin of flukes. *Ziphiidae*

3_2 No grooving on throat; dorsal fin when present at or near middle of body; notch in middle of hinder margin of flukes.

4_1 Seven cervical vertebrae all separate from one another.

5_1 Dorsal fin absent or rudimentary; beak absent; inhabits Arctic regeon. *Monodontidae*

5_2 Dorsal fin present but almost low; beak extremely long (1/6 to 1/7 of body length); inhabits tropical fresh water; teeth very numerous in upper and lower jaws. *Platanistidae*

4_2 Two or more cervical vertebrae fused.

6_1 Only atlas and axis fused.

7_1 Beak long and narrow (breath of snout less than 1/2 of its length); more than 20 teeth in each row of upper jaw; size small (less than 13 feet). *Delphinidae*

7_2 Beak absent; less than 20 teeth in each row of upper jaw; size small. *Orcellidae*

6_2 Not only atlas and axis fused, but also third or more cervical vertebrae fused.

8_1 Head without distinct beak; each row of upper teeth more than 15; body length less than 8 feet. *Phocaenidae*

8_2 Head without distinct beak; each row of upper teeth less than 15; body length more than 8 feet.

9_1 Teeth present in upper jaw. *Globicephalidae*

9_2 Teeth absent in upper jaw. *Globidelphinidae*

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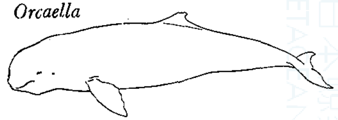
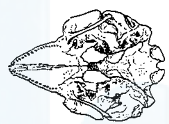
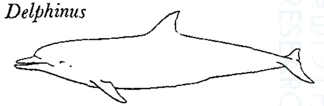
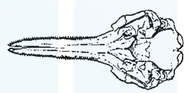
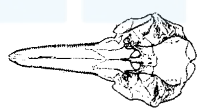
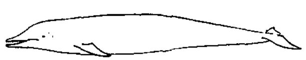
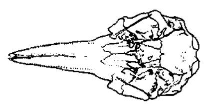
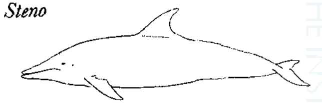
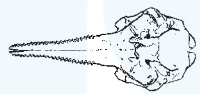
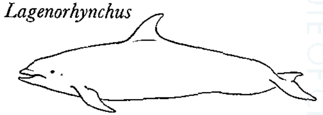
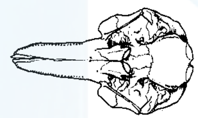
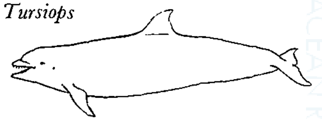
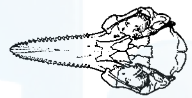
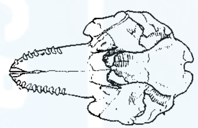
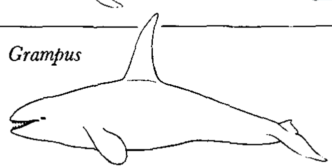
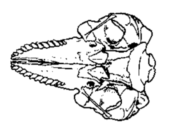
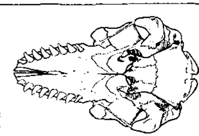
Appendix: Body form and osteological characters on the various genera of smaller toothed whales.

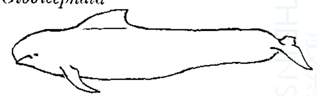
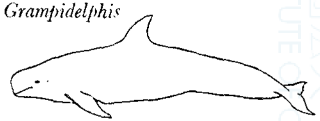
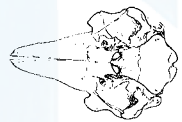
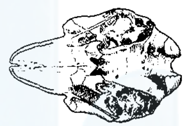
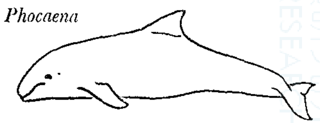
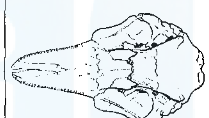
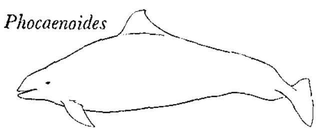
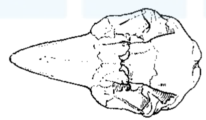
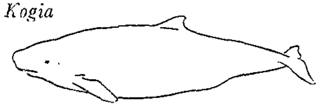
Genus name and out line of typical body form	Body length in feet	Ventral view of skull of typical species	Number of vertebrae (Detailed number with number of fused cervicals & number of two headed ribs)	Number of phalangeal bones (Included metacarpals)	Dentition $\frac{\text{Upper}}{\text{Lower}}$ of a side	Length/breath ratio (in typical species) of rostrum	Length/breath ratio (in typical species) of skull
Monodon 	12		50~55 C : 7 (0) D : 11~12 (?) L : 6~10 Ca : 26~27	I : 1~2 II : 5~8 III : 4~6 IV : 2~4 V : 2~3	1/0	1.31	1.66
Delphinapterus 	18		50~52 C : 7 (0) D : ~ (?) L : ~ Ca : ~	I : 1~2 II : 6~9 III : 4~5 IV : 2~4 V : 2~4	8~10/8~10	1.50	1.79
Orcaella 	7		62~63 C : 7 (2) D : 13~14 (8) L : 13~14 Ca : 27~28	I : 2 II : 8 III : 6 IV : 3 V : 0~1	15~17/12~14	1.10	1.41
Delphinus 	7 1/2		73~76 C : 7 (2) D : 14~16 (4) L : 21~23 Ca : 31~34	I : 1~2 II : 7~9 III : 6~7 IV : 2~4 V : 1~2	47~65/47~65	2.93	2.22
Stenella 	8		68~81 C : 7 (2) D : 14~16 (4) L : 21~24 Ca : 31~35	I : 1 II : 9 III : 7 IV : 4 V : 1	34~56/34~56	2.40	2.00
Lissodelphis 	8		88~90 C : 7 (2) D : 14~15 (5) L : 29~30 Ca : 37~39	I : 1~2 II : 8 III : 6 IV : 3 V : 2~3	40~43/42~46	2.18	2.17

Appendix (continued)

Genus name and out line of typical body form	Body length in feet	Ventral view of skull of typical species	Number of vertebrae (Detailed number with number of fused cervicals & number of two headed ribs)	Numrbe of phalangeal bones (Included metacarpals)	Dentition Upper/Lower of a side	Length/breath ratio (in typical species) of rostrum	of skull
Steno 	8		66 C : 7 (2) D : 13 (4～5) L : 15～16 Ca : 30～31	I : 3 II : 8～9 III : 6～7 VI : 3 V : 2	20～27 / 20～27	3.18	2.25
Lagenorhynchus 	9		73～92 C : 7 (2) D : 14～15 (6) L : 18～22 Ca : 38～41	I : 1～2 II : 10 III : 6 IV : 2～3 V : 2	22～45 / 22～45	2.02	1.74
Tursiops 	12		61～66 C : 7 (2) D : 12～14 (5) L : 17～19 Ca : 26～29	I : 1～2 II : 7～9 III : 5～8 IV : 2～3 V : 1～2	20～26 / 20～26	2.32	2.04
*Feresa** 	8		67～68 C : 7 (3) D : 12 (6) L : 16 Ca : 32～33	I : 2～3 II : 8～9 III : 7～8 IV : 3～5 V : 2～3	10～12 / 10～13	1.84	1.62
Grampus 	30		50～52 C : 7 (4) D : 11～12 (6) L : 10 Ca : 21～24	I : 2 II : 6～7 III : 4～5 IV : 3～4 V : 2～3	10～13 / 10～13	1.36	1.36
Pseudorca 	18		50 C : 7 (6) D : 10 (6) L : 9～10 Ca : 22～24	I : 1 II : 6 III : 5 IV : 2 V : 1	8～11 / 8～11	1.49	1.62

* A herd of *Feresa* (seven males and seven females) was caught in the Sagami Bay of the Pacific coast of Japan, on 28 January 1962. All of them are being examined at the Whales Research Institute, Tokyo.

Appendix (continued)

Genus name and out line of typical body form	Body length in feet	Ventral view of skull of typical species	Number of vertebrae (Detailed number with number of fused cervicals & number of two headed ribs)	Number of phalangeal bones (Included metacarpals)	Dentition Upper/Lower of a side	Length/breath ratio (in typical species) of rostrum	of skull
Globicephala 	28		57~60 C : 7 (6) D : 11~12 (6) L : 12~14 Ca : 28~29	I : 3~ 4 II : 9~14 III : 9~11 IV : 2~ 3 V : 1~ 2	0 / 2~7	1.30	1.50
Grampidelphis 	13		68~69 C : 7 (6) D : 12~13 (6) L : 17~18 Ca : 30~31	I : 2 II : 8~10 III : 5~ 8 IV : 3~ 5 V : 1	7~12 / 7~12	1.04	1.25
Neomeris 	6		58~63 C : 7 (5) D : 13~14 (11) L : 12~13 Ca : 25~31	I : 2 II : 5~7 III : 5~6 IV : 3 V : 2	15~19 / 15~19	1.03	1.51
Phocaena 	6		62~66 C : 7 (6) D : 12~14 (10) L : 14~17 Ca : 27~32	I : 1~ 3 II : 5~10 III : 5~ 8 IV : 2~ 6 V : 1~ 3	23~27 / 23~27	1.39	1.75
Phocaenoides 	7		92~98 C : 7 (7) D : 15~18 (12) L : 24~27 Ca : 44~49	I : 1 II : 6 III : 4~5 IV : 1~2 V : 0~1	23~27 / 23~27	1.47	2.10
Kogia 	13		50~51 C : 7 (7) D : 12~13 (8) L : 10~12 Ca : 24~27	I : 2 II : 5~8 III : 4~8 IV : 4~8 V : 2~7	6~8 / 9~16	0.79	1.03