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Ethogram of Yangtze finless porpoise calves (*Neophocaena phocaenoides asiaeorientalis*)

XIAN Yi-Jie[1,2], WANG Ke-Xiong[1], JIANG Wen-Hua[3], ZHENG Bang-You[3], WANG Ding[1,*]

(1. *Institute of Hydrobiology, the Chinese Academy of Sciences, Wuhan* 430072, *China;* 2. *Graduate University of the Chinese Academy of Sciences, Beijing* 100049, *China;* 3. *Tongling Freshwater Porpoise National Nature Reserve, Tongling* 244161, *China*)

Abstract: Underwater behavioral patterns of one Yangtze finless porpoise (*Neophocaena phocaenoides asiaeorientalis*) calf in captivity and those performed on the water surface by two calves in semi-natural environment were focally followed and continuously recorded until one year postpartum to construct the ethogram. The results indicate that 1) the three calves could display diverse and active behavioral patterns; 2) soon after birth, patterns critical for survival appeared first; 3) playful and social patterns predominated the ethogram; 4) most of the patterns were alike across age classes; 5) most of the patterns appeared at the calves' early life stage. It is possible that the above characteristics are adaptively shaped by the aquatic and social life of this subspecies.

Key words: *Neophocaena phocaenoides asiaeorientalis*; Calf; Behavioral pattern; Aquatic environment

幼年长江江豚的行为谱

先义杰[1,2], 王克雄[1], 蒋文华[3], 郑邦友[3], 王 丁[1,*]

（1. 中国科学院水生生物研究所，湖北 武汉 430072；2. 中国科学院研究生院，北京 100049；
3. 铜陵淡水豚国家级自然保护区，安徽 铜陵 244161）

摘要：采用焦点动物跟踪法及连续记录法，观察了人工饲养条件下一头幼年长江江豚（*Neophocaena phocaenoides asiaeorientalis*）的水下以及半自然条件下两头幼豚的水面行为型式。观察时间最长持续至出生后一年，以构建其行为谱。结果显示：1) 所有幼豚都能表现出丰富多样且活跃的行为型式；2) 幼豚刚出生时，与存活攸关的行为型式最先出现；3) 具有玩耍和社居性质的行为型式在行为谱中占大部分；4) 幼豚大部分行为型式已与其他年龄段个体的相似；5) 大部分行为型式出现在生命的早期阶段。以上特征可能是这种动物对水生和社居生活的适应。

关键词：长江江豚；幼豚；行为型式；水生环境
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For ethological studies, particularly species-oriented ones, clear, concise and comprehensive description of characteristic behaviors, i.e. the construction of ethograms, is fundamental (Brown, 1975; Lehner, 1996). In this sense, behavioral observations across all age-sex classes under different environments are needed so that understanding of Tinbergen's (1963) four questions about behavior (function, causation, ontogeny and evolution) can be illuminated by inter- and intra-species comparisons. In the field of animal conservation and welfare, an operational ethogram can be used to evaluate the achievement of our efforts (Banks, 1982; Gonyou, 1994; Jiang, 1997).

As one of the most modified mammals, cetaceans have evolved to assume many behavioral patterns greatly different from their terrestrial counterparts to adapt to the aquatic environment (Clutton-Brock & Wilson, 2002). For a long time, these fascinating patterns have

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*通讯作者（Corresponding author），Tel: +86-27-68780178; Fax: +86-27-68780123; E-mail: wangd@ihb.ac.cn

stimulated our interest and have been profusely documented — examples include spy hop, tail lift and breach in bottlenose dolphins (*Tursiops truncatus*) (Müller et al, 1998) and killer whales (*Orcinus orca*) (reviewed in Heyning & Dahlheim, 1988). In previous studies, although calves have been included, systematic descriptions of their behavioral patterns are scarce, with exceptions such as Mann & Smuts (1999) for bottlenose dolphins (*Tursiops* sp.) and Miles & Herzing (2003) for Atlantic spotted dolphins (*Stenella frontalis*). In general, this situation can be attributed to 1) difficulty in subject availability (Herman & Tavolga, 1980), especially for endangered species; 2) the common problems in cetological research, i.e. the often impossible access to and following of the focal animals in their open and wide habitat for a long period (Mann, 1999) and 3) researcher's interest (e.g. Gubbins et al, 1999).

According to Barnard (2004), young animals can display diverse behavioral patterns especially in playful context. In cetacean calves, these include swimming, socio-sexual interaction, object manipulation and investigation etc., which may have adaptive significance in refining their motor, foraging, social and reproductive skills for present and future life (Herman & Tavolga, 1980; Mann & Smuts, 1999; Mann, 2006). Therefore, to study cetacean calves' behavioral patterns on one hand may further our understanding of this mammal's adaptations to their aquatic environment. On the other hand, this work may help us to trace the components of adult behavioral patterns back to those in childhood, so that maturation of the patterns together with their underlying mechanisms can be revealed (Herman & Tavolga, 1980; Mann, 2006).

The Yangtze finless porpoise (*Neophocaena phocaenoides asiaeorientalis*) is one of the smallest toothed whales, only distributed in the middle and lower reaches of the Yangtze River and its main tributaries (Gao & Zhou, 1995). As a victim of intensive human activities, their population size has dramatically decreased from around 2700 in the early 1990s (Zhang et al, 1993) to 1800 in 2006 (Zhao et al, 2008). According to IUCN criteria, their protective status is recommended to being upgraded from "Endangered" (Baillie & Groombridge, 1996) to "Critically Endangered" (Zhao, 2009).

To protect this subspecies, several captive facilities and semi-natural reserves have been established since the late 1980s. Under these circumstances, individual identification and long term behavioral observation on this small-sized, timid- and elusive-tempered (Jefferson & Huang, 2004) and turbid-water living cetacean become possible (e.g. Jiang, 2000; Xiao & Wang, 2005). With calves introduced into captivity and born in semi-natural reserves, several descriptions on their behavioral patterns have been carried out (e.g. Hua et al, 1993; Yang & Chen, 1996; Wang, 1998; Wei et al, 2002; Jiang & Yu, 2006). However, the studies defined the patterns broadly and their observational periods were relatively short. In the present study, we longitudinally followed the underwater behavioral patterns of one captive-born calf during the first year postpartum. In addition, patterns performed on the water surface by two semi-natural born calves were also followed until one year postpartum. Based on these efforts, an ethogram including the day age when each pattern was first observed was constructed and functions of the patterns were discussed.

1 Material and Methods

1.1 Subjects and housing management

The first subject was the world's first captive-born calf of Yangtze finless porpoise in Baiji Dolphinarium, Wuhan, Hubei Province, China, born on July 5 2005 and called Terry (Wang et al, 2005). He lived with four adults: his parents, one other female and one other male. The housing system of the dolphinarium includes a kidney-shaped pool [20 m×(7 − 8) m×3.5 (depth) m] and a round pool (diameter=10 m, depth=3.5 m), which are connected by an underwater corridor [1.7 m×1.4 m×2 (depth) m]; there are eight rectangular windows (2 m×1.5 m each) on the walls of both pools: seven for the kidney-shaped pool and one for the round pool (Liu, 1997). Through the windows, the animals were observed in the present study. A close-circuit filter system recycles the water four times a day. During the year, the water temperature is controlled between 8 − 30℃ depending on the season.

From March 15, 2005 to March 6, 2006, the underwater corridor was gated by a metal fence. As a result, the mother, the calf and the other adult female were left in the kidney-shaped pool, while both adult males (including the father of Terry) were housed in the round pool. This practice was necessary when considering the adult males' potential abuse on the mother and calf. Fish (mainly crucian carps, *Carassius auratus*) was provided for the adults during the four regular feedings at 8:30 − 9:00, 11:30 − 12:00, 14:30 − 15:00 and 16:50 − 17:20 each day (about 1 kg/meal for each individual). To fulfill the nutritional requirement of the mother, an extra meal was supplied at 20:00 − 20:30 from winter 2004 to spring 2006. When Terry started to ingest fish at 98 d of age, he was fed in accordance to his mother's schedule. For other information of Terry and the housing management, see Xian et al (2010).

The second and third subjects were C06 (male) and C07 (sex unknown) born to different mothers in July 13, 2006 and August 13, 2007 respectively in the semi-natural water of Tongling Freshwater Porpoise National Nature Reserve, Tongling, Anhui Province, China. The two calves lived with another four to five individuals including the parents. C06 died from an accident on his 109 d postpartum. The semi-natural water is a former side channel (30°48′−30°49′N, 117°43′ − 117°44′E) of Yangtze River and has been completely enclosed by Heyue Islet and Tieban Islet since the end of 1993. Now, the channel is about 1600 m long and 80 − 220 m wide with flat and sandy bed. In drought season, water is pumped in from the Yangtze River. During the study, the water level of the deepest area fluctuated between 4 − 5 m, and the temperature 0.3 m under the water surface changed between 0 − 38°C. Although the porpoises can forage in the channel, they are still fed with fish (mainly *Carassius* sp., *Cyprinus* sp., *Hypophthalmichthys* sp. and *Ctenopharyngodon* sp.). Feeding is regularly conducted at 9:00 − 9:30 and 14:00 - 14:30 each day, with about 2 kg/meal provided for each individual except the calves. In contrary to C06 which was not observed to feed on fish throughout his 109 d of life, C07 started to feed at 87 d postpartum and fish was provided for it since then until the end of the study.

1.2 Sampling and recording methods

In captivity, focal following and continuous recording methods (Martin & Bateson, 1993; Lehner, 1996) were used to study Terry's underwater behavioral patterns. Before 3.5 d of age, the patterns were recorded on the data sheet day and night. After that until 364 d postpartum, the patterns were video-recorded according to the following design. On each Sunday and Wednesday, during the whole daytime, a recording session lasting 10.5 min was randomly selected from each natural hour. The video-recording was carried out near the underwater windows by an observer equipped with a Sony® DCR-VX1000E digital video camera. Given the potential disturbance of human activities on the animals' behaviors, some recordings should be conducted 20 min before or after the feeding.

Produced by a Panasonic® NV-DV2000 digital video cassette recorder and the software of 10 Moons© DV 1-2-3, all the videos recorded in captivity were real-time transformed into mpeg 2 format and stored in the hard disk. Videos were manually played back with speed 4 times faster than the real-time. When a new behavioral pattern was detected, the video was paused and then played frame by frame to record the pattern together with the day age. For other information of the sampling and recording methods, see Xian et al (2010).

At the channel in Tongling, the focal following and continuous recording methods were also adopted. In the day time, behavioral patterns performed on the water surface by C06 and C07 were visually observed. For C06, observations were carried out everyday from birth to 18 d postpartum, every other day from 19 − 76 d and every 2 − 3 d from 77 − 109 d; for C07, observations were conducted everyday from birth to 30 d of age, every other day from 31 − 62 d, every 2 − 3 d from 63 − 255 d and every 7 d from 256 to 364 d. During each working day, an observational session lasting 2 h was selected from dawn to 8:30, 10:00 − 13:30 and 15:00 to dusk respectively. A data sheet was used to record each new behavioral pattern of the two calves together with the day age. During the study, the observer who was situated on the channel bank as high as 6 m, closely followed the focal individual. Naked eyes and a pair of Fujinon® binoculars (7 × 50 mm) were alternatively used according to the distance between the animal and observer. Generally, the distance was kept between 30 − 200 m, a tradeoff between minimizing the observer's potential disturbance on the animal's behaviors and observational reliability.

1.3 Ethogram construction

We referenced to the description and terminology used in bottlenose dolphins (Müller et al, 1998; Mann & Smuts, 1999) and captive Yangtze finless porpoises (Xiao & Wang, 2005) but made substantial modifications in the present study. For the sake of objectivity, functional description of the behavioral pattern was avoided unless there was evidence to support it (reviewed in Lehner, 1996). According to the context and main body part involved (Müller et al, 1998), all the behavioral patterns were classified to construct the ethogram, in which the day age when each behavioral pattern was first observed was noted.

2 Results

In captivity, during Terry's first 3.5 d postpartum, the total sampling time was 84 h. From 3.5 to 364 d postpartum, 99 working days led to 181.9 h of videos (1.8 ± 0.5) h/d. In the channel, from birth to 109 d of life for C06, during 49 d of observation, the sampling time amounted to 284.9 h (5.8 ± 0.8) h/d; for C07, from its birth to 364 d postpartum, during 114 d of observation, the hour count was 656.2 h (5.8 ± 0.8) h/d.

In sum, 49 behavioral patterns were described in captivity, 50 in the channel, among which 38 were shared by both calves, and 5 and 7 were exclusively recorded for C06 and C07, respectively. All of the patterns were classified into 11 categories to construct the ethogram (Tab. 1).

Tab. 1 Ethogram of the calves based on observations underwater or on the surface

Category	Behavioral pattern	Description	Observed age (d)		
			Terry	C06	C07
Respire	Respire	Open the blowhole and exhale air with clear sound	1	1	1
	Chuff	Release air from the blowhole abruptly and wheezingly when fine cone-shaped vapor may rise up overhead		34	13
	Sneeze	Expulse air from the blowhole audibly and briefly that sounds like air escaping through the tightened neck of a balloon		58	
Swim	Move	Progress by shaking the tail	1	1	1
	Rush	Move forward swiftly and violently resulting big waves on the surface	19		
	Mill	Change the moving direction and speed frequently		40	
	Glide	Move forward with the help of inertia			252
	Reverse	Change the moving direction completely and suddenly	145		
	Ring	Cycle horizontally with the radius of one body length			29
	Circle	Revolve around other objects	169		
	Echelon position swim	Swim in parallel with the mother within her 0.5 body length while slightly positioning above her flank	1	1	1
	Infant position swim	Swim closely under the mother's genital region	1	1	1
	Head-up swim	Orient the head out of water and move forward, clearing the surface in dorsal position		76	17
	Ventral-up swim	Move forward with abdomen upwards	51		
	Ground swim	Swim underneath with any body part touching the ground	1		
	Crest swim	Push crests ahead when moving swiftly underwater			58
	Bubble swim	Produce large amount of bubbles when exploring underwater, making the surface as if being boiled			36
Surface and dive	Surface	Move towards the surface in dorsal position	1	1	1
	Synchronous surface	Surface synchronously with the mother when both in echelon position swim	1	1	1
	Delayed surface	Surface tightly from the mother's flank when she starts to submerge, and then cycle back to the original infant position	1	1	1
	Revolved surface	Surface with the long body axis revolving	33		
	Motionless surface	Surface without any movement	82		
	Dive	Submerge from the surface into the water	1	1	1
	Arch dive	Lunge Abruptly over the surface and fluently re-enter the water in dorsal position with a conspicuous arch, while the tail remains submerged and serves as the pivot in lowering the fore-section	1	13	11
	Fluke-out dive	Dive with the fluke exposed out of water			78
Interact	Touch	Contact any body part on the surface of another individual briefly	1	1	1
	Rub	Move any body part along the surface of another individual or object smoothly and steadily	1	1	1
	Hit	Strike the tail on the surface of another individual noisily	292		
	Climb	Move onto a submerging individuals' back and turn over, with the belly, flipper and fluke exposed		64	17
	Mount	Stay closely on another individual's back or tail and move with it	1	4	15

(to be continued)

(continued)

Category	Behavioral pattern	Description	Observed age (d)		
			Terry	C06	C07
	Follow	Swim behind and towards another progressing individual far away from the latter's one body length	1	1	1
	Approach	Swim into the radius of one body length of another individual which keeps relatively still	1	11	9
	Leave	Swim out of the radius of one body length of another individual which keeps relatively still	1	11	16
	Group	Aggregate with another or other individual(s) while the distance between any of them is within two body length of adults	1	1	1
	Sexual play	Arch the genital region towards the counterpart of another individual. Sometimes penis erection, intromission and thrust can be observed	33		
Aerial behavior	Decline	Lift the fore-section vertically or obliquely, and forward clear the surface until submergence		70	18
	Stiff lunge	Extend the long axis straightly, thrust into the air completely in vertical or oblique gesture and retreat along the original routine smoothly or slap the surface with the belly noisily		17	2
	Breach	Lift the fore-section obliquely in lateral or ventral position and land noisily on the water surface with the side		62	19
	Bow	Thrust into the air in dorsal position and assume an apparent arch at the peak. In descent, the peduncle remains relatively stationary or moves upward as the fore-section falls down. Distance between the start and re-entry points is within one body length		30	12
	Leap	Thrust into the air in dorsal position and assume a slight arch at the peak, resulting in clean or noisy dropdown. Distance between the start and re-entry points is more than one body length		20	12
	Porpoise	Thrust into the air in dorsal or lateral position with the peduncle arched down the water surface, resulting in noisy dropdown. Distance between the start and re-entry points is more than one body length		70	18
Stationary behavior	Sink	Fall down to the ground without any movement	152		
	Circle fall	Fall down freely with head first, circling round a supposed column	138		
	Float	Keep still on the surface while the head and/or tail can bend down or expose out of water	19	50	9
	Hang	Stay vertically in the water column, sometimes with head touching the surface slightly	103		
	Lie	Stay motionless on the ground in dorsal position	208		
	Arch	Bend the head and/or tail to form arch, concave or "S" shape	19		
Mouth movement	Bubble manipulate	Expel bubbles from the mouth or blowhole	75		
	Ring manipulate	Expel rings from the mouth	138		
	Object manipulate	Chase, spit, lift or bite small fish, feces piece, plants, etc.	33	32	58
	Spit	Shoot a thin water stream into the air while floating or being underwater	51	24	92
	Mouth open	Open the upper and lower jaw in non-feeding occasion	51	72	
	Mouth jerk	open and shut the upper and lower jaw repeatedly		76	
	Suckle	Attach the lip on the mother's teat tightly	1		
	Ingest	Swallow fish directly	98		87
Head movement	Head thrust	Rush the head out of water vertically, slapping the jaw on the surface noisily when falling down		1	1
	Head lift	Expose the head vertically or obliquely out of water, keeping motionless or scanning around		12	141

(to be continued)

(continued)

Category	Behavioral pattern	Description	Observed age (d)		
			Terry	C06	C07
	Head jerk	Move the head inward and outward, or from side to side	33	56	77
	Head bump	Bump the head onto the surface of another individual or object	1	83	4
	Spy hop	Lift the fore-section vertically out of water and then retreat along the original routine with the flipper waving sometimes	53	48	16
	Chin slap	Raise the head in dorsal position and strike against the surface noisily	1	66	
Trunk movement	Vibrate	Expose and retreat the trunk continuously	337		252
	Tumble	Revolve the body in the column with the body center as the pivot	75		
	Roll	Revolve around the long axis continuously	33	12	62
	Over turn	Turn from side to side		22	4
Tail movement	Tail lift	Expose the tail vertically or obliquely out of water with the fluke curled sometimes		40	32
	Tail wave	Move the tail up and down or sideways		64	1
	Tail slap	Strike the tail on the surface noisily, resulting in progress		95	85
	Tail concave	Bend the tail backwards	33		
	Twist	Curl the tail on the counterpart of another individual while swimming under it	26		
Others	Defecate	Expel feces	1		
	Erect	Expose the penis	37		

3 Discussion

According to Chen et al (1992), behavioral patterns of the finless porpoise are dull. In the present study, however, the three calves could perform diverse and active patterns underwater or on the surface, such as Rush, Ring, Leap and Spit. In previous studies, researchers have recorded as many as 40 patterns in juveniles, sub-adults and/or adults of the Yangtze finless porpoise (Hua et al, 1993; Wang, 1998; Xiao & Wang, 2005). Hence, the behavioral description made by Chen et al (1992) is not appropriate for this subspecies.

In our ethogram, there are 8 behavioral patterns (Respire, Move, Echelon position swim, Infant position swim, Surface, Synchronous surface, Delayed surface and Dive) observed for the three calves during their first day of life. In the animal kingdom, although behavioral development varies across species, it is predicted that behavioral patterns critical for survival should appear earliest in life (reviewed in Barnard, 2004). Different from the young of many terrestrial mammals such as rodents and carnivores, to survive in their aquatic environment, cetacean calves should be able to respire, swim, surface and dive soon after parturition. During the phylogenetic process, they have evolved to take on precocious locomotion, buoyant physical form and close mother-calf bond (Tavolga & Essapian, 1957; Cockroft & Ross, 1990; Mann & Smuts, 1999). In this way, the calves in the present study could quickly acquire the above patterns soon after birth.

During the three calves' first day of life, besides the above survival-critical patterns, some playful and social patterns such as Touch, Rub, Follow and Group were also observed. Throughout the whole study period, many of the calves' patterns were playful and social — as seen in many other young mammals (Barnard, 2004) including bottlenose dolphins (Gurevich, 1977). For toothed whales which should move continuously in water and live a complex social life (Connor et al, 1998), the development of diverse playful and social patterns in childhood may help them to enhance neuromuscular competency, practice adult patterns, generate novel patterns and negotiate social relations (Barnard, 2004). Take "Object manipulate" in the present study for example, no matter what the underlying motivation was, this pattern might be important for the calves' subsequent maturation of feeding/foraging behavior as seen in bottlenose dolphins (Mann & Smuts, 1999).

Despite the great difference in observational period between C06 and C07 (109 vs. 365 d), their numbers of behavioral patterns are comparable (43 vs. 45, with 38 shared). Moreover, most of their patterns have been alike those in other age classes of the Yangtze finless porpoise (Hua et al, 1993). Similarly, most of Terry's patterns have also been alike those in the sub-adults and adults (Wang, 1998; Xiao & Wang, 2005). For the three calves, a large amount of patterns appeared at their early life stage. It is possible that these characteristics are related to their quickly improved locomotion abilities. In bottlenose dolphins, the similar situation has also been found (Gurevich, 1977).

From above, we can see that the three calves shared many aspects of behavioral patterns, even though they lived in two different environments. One difference is that C06 and C07 were observed to display vigorous aerial patterns such as Breach, Bow and Leap, but it is not for Terry. In other age classes of this subspecies in captivity and the channel in Tongling, a similar difference has also been noted (Xiao & Wang, 2005; personal observation). It is likely that release of the aerial patterns has been suppressed in captivity with limited space, hard wall, etc. From the perspective of adaptation, the suppression of aerial patterns in captivity might protect the calf from accidental injuries and stranding.

Although our findings are only from three calves in captive and semi-natural environments, this work further enriches our knowledge about behavioral biology of the Yangtze finless porpoise. Moreover, it gives implications in management and conservation of this subspecies, e.g. environmental enrichment is needed to fully release the calves' behavioral patterns particularly at their early life stage. Since behavioral development is an ongoing process (Barnard, 2004), to closely follow the change of the patterns over a long period is needed in the future.

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References:

Baillie J, Groombridge B. 1996. 1996 IUCN Red List of Threatened Animals [M]. Gland (Switzerland): IUCN.

Banks EM. 1982. Behavioral research to answer questions about animal welfare [J]. *J Anim Sci*, **54**: 434-446.

Barnard CJ. 2004. Animal Behaviour: Mechanism, Development, Function and Evolution [M]. Essex (England): Pearson Education Limited.

Brown JL. 1975. The Evolution of Behavior [M]. New York: W. W. Norton & Company, Inc.

Chen W, Zheng C, Zhang Q. 1992. Marine Mammals [M]. Qingdao (China): Qingdao Ocean University Press. (in Chinese)

Clutton-Brock J, Wilson DE. 2002. Mammals [M]. New York (USA): DK Publishing, Inc.

Cockroft VG, Ross GJB. 1990. Observations on the early development of a captive bottlenose dolphin calf [M]//Leatherwood S, Reeves RR (eds). The Bottlenose Dolphin. San Diego (USA): Academic Press, 461-478.

Connor RC, Mann J, Tyack PL, Whitehead H. 1998. Social evolution in toothed whales [J]. *Trends Ecol Evolut*, **13**(6): 228-232.

Gao A, Zhou K. 1995. Geographical variations of external measurements and three subspecies of *Neophocaena phocaenoides* in Chinese waters [J]. *Acta Theriol Sin*, **15**(2): 81-92. (in Chinese)

Gonyou HW. 1994. Why the study of animal behavior is associated with the animal welfare issue [J]. *J Anim Sci*, **72**: 2171-2177.

Gubbins C, McCowan B, Lynn SK, Hooper S, Reiss D. 1999. Mother-infant spatial relations in captive bottlenose dolphins, *Tursiops truncatus* [J]. *Mar Mam Sci*, **15** (3): 751-765.

Gurevich VS 1977. Post-natal behavior of an Atlantic bottlenosed calf (*Tursiops truncatus*, Montagu) born at Sea World [M]//Ridgway SH, Benirschke K. Breeding Dolphins, Present Status, Suggestions for the Future. Washington D C: US Marine Mammal Commission Report MMC-76/07, 168-184.

Herman LM, Tavolga WN. 1980. The communication systems of cetaceans [M]//Herman LM. Cetacean Behavior: Mechanisms and Functions. New York: John Wiley & Sons, Inc, 149-209.

Heyning JE, Dahlheim ME. 1988. *Orcinus orca* [J]. *Mamm Spec*, **304**: 1-9.

Hua Y, Xiang C, Xu X, Zhang X. 1993. Observation on group behavior of black finless porpoise, *Neophocaena phocaenoides*, near the beach using the net-surroundings in the Yangtze River [J]. *J Fish Chn*, **17**(2): 120-125. (in Chinese)

Jefferson TA, Huang SK. 2004. *Neophocaena phocaenoides* [J]. *Mamm Spec*, **746**: 1-12.

Jiang WH, Yu DP. 2006. Preliminary observations on respiratory behavior of the Yangtze finless porpoise in the semi-nature aqueous reserve [J]. *Chn J Zool*, **41**(4): 97-99. (in Chinese)

Jiang W. 2000. Observation on the group of the Changjiang finless porpoise and conserved in semi-nature conditions [J]. *J Anhui Univ*: *Nat Sci Ed*, **24**(4): 106-111. (in Chinese)

Jiang Z. 1997. Ex situ conservation of species [M]//Jiang Z, Ma K, Han X. Conservation Biology. Hangzhou (China): Zhejiang Science and Technology Press, 148-167. (in Chinese)

Lehner PN. 1996. Handbook of Ethological Methods [M]. 2nd ed. Cambridge (London): Cambridge University Press.

Liu R. 1997. Rearing of the Baiji [M]//Chen P, Liu R, Wang D, Zhang X. Biology of Baiji, and Its Rearing and Conservation. Beijing (China): Science Press, 175-208. (in Chinese).

Mann J, Smuts B. 1999. Behavioral development in wild bottlenose dolphin newborns (*Tursiops* sp.) [J]. *Behaviour*, **136**(5): 529-566.

Mann J. 1999. Behavioral sampling for cetaceans: A review and critique [J]. *Mar Mamm Sci*, **15**(1): 102-122.

Mann J. 2006. Establishing trust: socio-sexual behaviour and the development of male-male bonds among Indian Ocean Bottlenose Dolphins [M]//Sommer V, Vasey PL. Homosexual Behaviour in Animals: An Evolutionary Perspective. Cambridge (London): Cambridge University Press, 107-130.

Martin P, Bateson P. 1993. Measuring Behavior: An Introductory Guide [M]. 2nd ed. Cambridge (London): Cambridge University Press.

Miles JA, Herzing DL. 2003. Underwater analysis of the behavioural development of free-ranging Atlantic spotted dolphin (*Stenella frontalis*) calves (birth to 4 years of age) [J]. *Aquat Mamm*, **29**(3): 363-377.

Müller M, Boutière H, Weaver A, Candelon N. 1998. Ethogram of the bottlenose dolphin (*Tursiops truncates*) with special reference to solitary and sociable dolphins [J]. *Vie Milieu*, **48**(2): 89-104.

Tavolga MC, Essapian FS. 1957. The behavior of bottlenose dolphin (*Tursiops truncatus*): mating, pregnancy, parturition and mother-infant behavior [J]. *Zoologica*, **42**(1):11-31.

Tinbergen N. 1963. On aims and methods of ethology [J]. *Z Tierpsychol*, **20**: 410-433.

Wang D, Hao Y, Wang K, Zhao Q, Chen D, Wei Z, Zhang X. 2005. The first Yangtze finless porpoise successfully born in captivity [J]. *Environ Sci Pollut Res*, **12**(5): 247-250.

Wang K. 1998. Behavioral Development of the Yangtze Finless Porpoise (*Neophocaena phocaenoides asiaeorientalis*) during the Early Captive Period [D]. MS thesis, Graduate University of Chinese Academy of Sciences, Beijing. (in Chinese)

Wei Z, Wang D, Kuang X, Wang K, Wang X, Xiao J, Zhao Q, Zhang X. 2002. Observations on behavior and ecology of the Yangtze finless porpoise (*Neophocaena phocaenoides asiaeorientalis*) group at Tian-E-Zhou Oxbow of the Yangtze River [J]. *Raff Bull Zool*, **10**(Suppl): 97-103.

Xian Y, Wang K, Dong L, Hao Y, Wang D. 2010. Some observations on the sociosexual behavior of a captive male Yangtze finless porpoise calf (*Neophocaena phocaenoides asiaeorientalis*) [J]. *Mar Freshw Behav Physiol*, **43**(3): 221-225.

Xiao JQ, Wang D. 2005. Construction of ethogram of the captive Yangtze finless porpoises, *Neophocaena phocaenoides asiaeorientalis* [J]. *Acta Hydrobiol Sin*, **29**(3): 253-258. (in Chinese)

Yang J, Chen P. 1996. Movement and behavior of finless porpoise (*Neophocaena phocaenoides* Cuvier) at Swan Oxbow, Hubei province [J]. *Acta Hydrobiol Sin*, **20**(1): 32-40. (in Chinese)

Zhang X, Liu R, Zhao Q, Zhang G, Wei Z, Wang X, Yang J. 1993. The population of finless porpoise in the middle and lower reaches of Yangtze River [J]. *Acta Theriol Sin*, **13**(4): 260-270. (in Chinese)

Zhao X, Barlow J, Taylor BL, Pitman RL, Wang K, Wei Z, Stewart BS, Turvey ST, Akamatsu T, Reeves RR, Wang D. 2008. Abundance and conservation status of the Yangtze finless porpoise in the Yangtze River, China [J]. *Biol Conserv*, **141**(2): 3006-3018.

Zhao X. 2009. Investigation of Survey Methodology on the Abundance of Cetaceans in Riverine Systems and its Applications [D]. Ph.D. thesis, Graduate University of Chinese Academy of Sciences, Beijing. (in Chinese)

中国科学院水生生物研究所鲸类保护生物学学科组简介

鲸类保护生物学学科组的前身是 1978 年秋成立的白鱀豚研究组。本学科组致力于白鱀豚、江豚、中华白海豚和扬子鳄等国家重点保护水生珍稀野生动物的保护生物学研究，重点研究濒危动物致危的内部与外部机理，种群动态监测理论和方法，小种群生物学和物种复壮理论，濒危动物繁殖理论和技术。围绕物种保护问题，深入开展种群生态学、繁殖生物学、行为学、声学，以及保护遗传学研究，重点解决自然保护和饲养繁殖的理论和实践问题。本学科组拥有占地 2 万平方米的白鱀豚馆和 3 千平方米的实验楼，现有生态学、声学和行为学、组织学和生理学、水化学及分子生物学实验室。目前，本学科组正开展如下研究：1）人工饲养和半自然条件下江豚繁殖理论与技术研究；2）建立江豚繁殖群体的研究；3）自然条件下白鱀豚、江豚和中华白海豚种群数量监测和栖息地保护研究；4）江豚、白鱀豚和中华白海豚保护遗传学研究；5）江豚、白鱀豚和中华白海豚的濒危机理和保护对策研究；6）江豚声学、行为生态学研究；7）扬子鳄、大鲵及海豹等珍稀水生动物声行为研究；8）水利工程建设对珍稀水生哺乳动物影响的评估及保护对策的研究。先后获省科技进步一等奖一次、二等奖两次和国家科技进步三等奖一次。学科组目前有职工和研究生共 24 人，现任组长为王丁研究员。我们期待和欢迎广大同行来本学科组进行合作交流。

先义杰，王　丁

（中国科学院水生生物研究所 鲸类保护生物学学科组，湖北 武汉 430072）