Inia geoffrensis in Captivity in the United States

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Abstract

The history of *Inia geoffrensis* in the United States covers a period of three decades which is characterized by the combined acquisition of as many as 70 animals over the first ten years, an abrupt decline in importation, and a loss of specimens leading to the current captive population of one. Data obtained from several institutions, available literature, and the personal files of the senior authors are reviewed. Such factors as the hazards of transport, longevity, maintenance conditions, necropsy findings, and comparisons between *Inia* and the more familiar marine species, *Tursiops truncatus,* are considered. Institutional data are additionally summarized in tabular form. The authors suggest that crowding and/or the overly aggressive behavior of *Inia* kept in groups contributes to the species' poor longevity record in captivity and that isolated individuals or animals that can be readily separated have a greater chance for survival in a captive environment.

在美国饲养的亚鳖豚　M.C.考德威尔[1]，D.K.考德威尔[1]和R.L.布里尔[2]，[1]佛罗里达海国，圣奥古斯汀，美国；[2]芝加哥动物学会，布鲁克菲尔德动物园，布鲁克菲尔德，美国

亚鳖豚在美国的历史经历了三个十年，在前十年加起来共获得70头，中间十年输入数剧减，后十年标本相继丧失以致到现在只有一头饲养的个体。对得自几个研究所的资料，已有的文献及第一作者的个人卷宗作了评述。考虑了运输的风险、寿命、饲养条件、尸体解剖中的发现等因素并与更常见的海生种宽吻海豚作了比较。研究所的资料另列表总结。作者们指出：群养的亚鳖豚的集群性及/或过强的攻击行为是此物种饲养寿命很短的原因，隔离的个体或迅速从群体中分出的动物在饲养环境中有较大的生存机会。

Historical Background

In 1956, Silver Springs of Ocala, Florida, sent an expedition to South America which brought back four Amazon River dolphins, *Inia geoffrensis,* captured in the Upper Amazon River in the vicinity of Leticia, Colombia. These four animals became the first live dolphins of their kind to be imported into the United States. Although one was dead upon arrival and another lasted only a day, the remaining two dolphins lived for over a year and were observed and monitored by Layne and Caldwell (1964).

Public aquaria and oceanaria apparently found these mammals of interest for, in the late 1950s and early 1960s, several either sent expeditions to South America or purchased one or more specimens from animal importers. The freshwater habitat of these dolphins enabled the aquaria to take advantage of the public interest in dolphins without having to build new and more costly saltwater facilities. The marine oceanaria could also expand their collections of cetaceans with a new and somewhat unusual species. The public, as it turned out however, never really distinguished *Inia* from the more familiar marine dolphins. Their popularity quickly waned and oceanaria did not continue to maintain them for very long. In the Caldwells' experience, when *Inia* were at the height of their popularity for institutional display more than one such institution would have continued to bear the high costs of importing and maintaining these unique dolphins had public interest supported it.

Institutions and attractions that have maintained *Inia* in the United States for public viewing include the Fort Worth Zoological Park in Fort Worth, Texas; Homosassa Springs in Homosassa Springs, Florida; the Aquarium of Niagara Falls in Niagara Falls, New York; the John G. Shedd Aquarium in Chicago, Illinois; the Milwaukee County Zoo in Milwaukee, Wisconsin; the Pittsburgh Zoo in Pittsburgh, Pennsylvania; the Steinhart Aquarium in San Francisco, California; Sea World in San Diego, California; Busch Gardens in Tampa, Florida; the Toledo Zoo in Toledo, Ohio; the Crandon Park Zoological Gardens in Miami, Florida; Marineland of Florida in St. Augustine, Florida (Fig. 1); and Marineland of the Pacific in Los Angeles, California.

Several animal importers included *Inia* in their collections as well and often provided public access to view them. These included the Tarpon Zoo of Tarpon Springs, Florida; the Monte Vista Zoological Park in Bloomington, California; the Gulf Fish Hatchery in Palmetto, Florida; the Paramount Aquarium in Vero Beach, Florida; and Animated Shippers in Miami, Florida. The United States Navy also maintained *Inia* for experimental studies at their facilities at Point Mugu in California and later on the Hawaiian island of Oahu, both for a short period of time.

According to the Caldwells' records, as of 1965, out of the 34 *Inia* that had been imported into the United States up to that time, only four were alive (Herald and Dempster, 1965). Just one year later in 1966, the total of animals imported had risen to more than 70, of which 19 were alive (Herald, 1967). We have

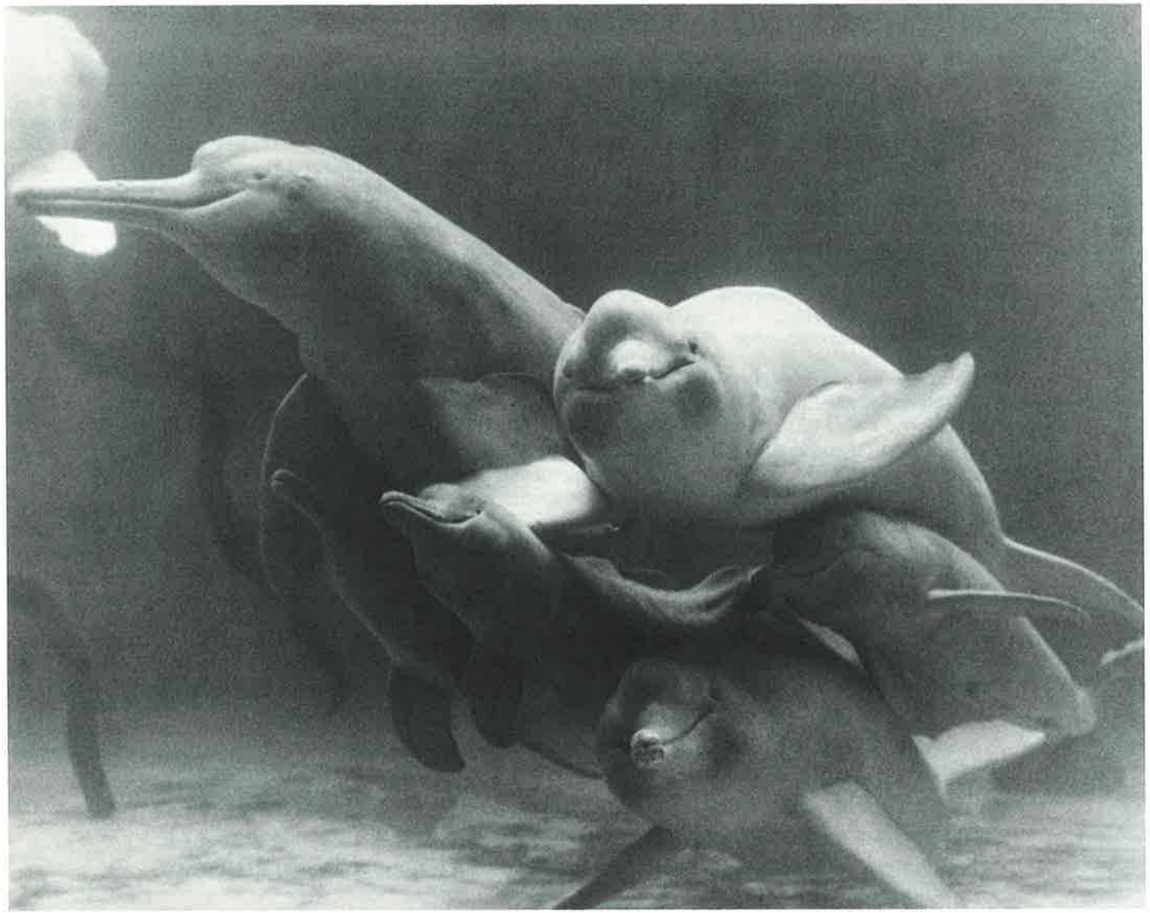

Figure 1. Originally predicted to be an advantage for success in captivity, the keeping of such large groups of *Inia geoffrensis* later proved to be a problem because of aggressive behavior. (Photograph by William A. Huck, courtesy Marineland of Florida.)

no figures for the total number of imports as of this writing (1986) but can report that only one *Inia* currently survives at the Pittsburgh Zoo. For whatever the reason, the rate of importation of the species rose rapidly and then abruptly declined to none. Legislation regarding marine mammals and endangered species in the United States, as well as the high costs involved in acquisition of these animals, have certainly contributed to this decline since the early 1970s.

Data Base

The present report is based on the records provided by six cooperating institutions that have held *Inia,* the literature, and the Caldwells' personal files. As might be expected, over the years the data at many institutions, all or in part, have been lost and what is available is, in many cases, difficult to interpret. Because of these and other limitations, we are restricting this report to material obtained from institutions within the United States. However, the species has also been held in both Europe and Japan (Best and da Silva, this volume; Tobayama and Kamiya, this volume; Collet, 1984) as well as South America. Even so, the following information should be helpful in bringing together what is available.

Transport

Before presenting the data on captive *Inia,* a brief word on transportation is in order. Those first dolphins brought to Silver Springs, Florida in 1956 had difficulty surviving the long, high-altitude flight (Allen and Neill, 1957), as did the animals brought back from Iquitos, Peru by Marineland of Florida in 1966. Herald (1967) mentioned similar problems as well and Dempster (1965) described the hazards of a comparatively shorter transport from Florida to California. Presumably, transport problems related to flight, altitude, and duration are characteristic of the species and we suggest may be alleviated by the administration of oxygen and/or cabin pressurization, keeping the animals warm in flight, and the initiation of a prophylactic antibiotic program prior to transport because experience has shown that these dolphins are prone to respiratory distress often leading to pneumonia and tend to be more subject to infection from cuts and abrasions often suffered in handling than marine dolphins. Methods of handling have, of course, improved since those early days when *Inia* were being widely imported, and consequently were the species more popular today the success in transporting them might be expected to be greater. However, the public is now more attuned to exciting and athletic shows with marine dolphins and killer whales and

Figure 2. "Golf-ball disease" shown in the center of this photograph of a live adult captive *Inia geoffrensis* is a common ailment of this species in captivity. Many of the small scars are the result of wounds inflicted through aggressive actions from other captives of the same species. (Photograph courtesy of Marineland of Florida.)

the interest in *Inia* is not likely to increase to the point of encouraging the importation of them in any significant numbers.

Conditions and Longevity in Captivity

The institutions from which data have been obtained account for a variety of captive conditions. These range from open-air artificial pools and natural springs to partially and completely enclosed artificial environments. The maintenance conditions are described in Table 1 where available.

We have calculated longevities of the animals listed in Table 1. Dolphins that were shipped to other institutions at some point after arrival at their initial destinations were excluded from the calculation of average longevity, as were those dolphins that were motherless calves, dead upon arrival or dead within 24 hours after arrival. We eliminated these latter cases on the grounds that death as a result of transport or a failure to wean does not fall within what would normally be expected relative to captive lifespan. The average captive longevity of the 35 remaining animals considered was 32.6 months.

Contributing causes of death are listed in Table 1 and cover a wide spectrum. In addition to those causes listed, gall stones and erysipelas (for a description of this condition see Geraci et al., 1966) have been reported in captive animals. "Lung problems" are prevalent in wild *Inia* (Best and da Silva, this volume) and pneumonia similarly appears to be the disease to most often attack otherwise healthy captive animals. Reports of skin problems may well be related overall to what has been described as the "golf ball disease" (Klocek, 1981; Pier and Madin, 1976 as cited by Best and da Silva, this volume) (Fig. 2). Both lung and skin problems encountered with *Inia* have, in some cases, been corrected by the use of antibiotics of choice.

The 32.6 month average captive longevity that we have calculated and the necropsy findings listed in Table 1, however, may not reflect the true state of affairs. We believe that the most serious health problems relative to *Inia* held in captivity are stress and injury induced by aggressive behavior between animals (Fig. 3). Much of the aggression is of a sexual nature. The files of the senior authors are replete with accounts of sexual attacks by males on females, on young of both sexes, and infants, including attacks on one dead infant. We no longer believe that a social breeding colony of this species in captivity, which appeared to be a desirable situation in the mid- to late 1960s, is possible. The attacks are too violent, putting some dolphins into shock and leaving on others gashes which are prone to infection. It is apparent to us that the fewer animals kept together, the better their chances for captive survival.

Most aquaria reported problems relative to aggression. The Fort Worth Zoological Park reported 47 copulations associated with aggression by a large male directed toward a female within a period of three hours and twenty-three minutes (McCusker, 1973). That situation was resolved by the placement of a fence between the two dolphins. Silver Springs similarly separated a large male from a smaller male by means of a fence (Layne and

Table 1
Conditions of *Inia* Captivity and Necropsy Results at Six Different Locations

Institution	Number Animals in Data Base	Tank Size in Gallons Water and/or Dimensions in Feet	Water Treatment (chlorine in ppm)	Water Temperature in °F	Air Temperature in °F	Fish Food Pounds/Animal and Type[1]	Necropsy Findings (may include several findings)
A	21	44 × 22 × 6′7″ plus 2 connecting of ca. 10.5 × 6 each, total ca. 44,000 plus gallons	0.4	72–73	ambient but enclosed	6–12 capelin, herring, and blue runner	nephrosis or other kidney problems (5), "golf ball disease" (1), scoliosis (2), skin problems (2), pneumonia (4), biliary inflammation (1), foreign object ingestion (1), subacute endocarditis (1), nothing found (3); not necropsied (4)
B	2	50 × 39 × 5 (maximum)	not known	not known	ambient but outdoors	not known	not known, but life spans included in averages
C	5	30 × 9.75 × 5 (maximum)	0.15–0.4	77–84	ambient but enclosed	6 mackerel, herring	nephritis, epidermal infection, spleenitis, peritonitis, bile duct hyperplasia, septicemia (3), bacterial pneumonia
D	2	initially ca. 15 × 15 × 6 with 6000 gallons, later 13,000 gallons	0.7	67–72	74–80	6–7 butterfish	recurrent skin problems, "Golf ball disease," teeth worn to gums
E	3	20 × 30 × 6 (maximum)	not known	80	76–80	7–8 smelt, Spanish mackerel, herring	occluded intestines, ulcers, congested liver, septicemia, thickened bladder wall, congestive heart failure
F	2	900 × 20–25 × 4–5 (maximum) (preferred deeper pools). Later moved to pen 75 × 40 × 5′10″	none	72	ambient	10–17 blue runner	pneumonia (2), brain hemorrhage, *Heterotrema caballeroi* found in lungs and trematode eggs in brain of one animal

[1] Food fishes: blue runner (*Caranx crysos*), butterfish (*Peprilus triacanthus* and *P. burti*), capelin (*Mallotus villosus*), herring (*Clupea harengus, Opisthonema oglinum*), mackerel (*Scomber scombrus*), smelt (*Osmerus mordax*), Spanish mackerel (*Scomberomorus maculatus*).
Many institutions administer dietary supplements, usually multivitamins, in capsules or pills inserted into some of the whole food fish.

Caldwell, 1964). The Toledo Zoo reported that a male became belligerent toward a smaller female who survived for only three weeks (Max Hofmeister, pers. comm., 1965). At Sea World in San Diego, a large resident male nearly knocked a newly introduced female completely out of the water (Caldwell and Caldwell, 1967).

The three *Inia* that have thus far survived the longest in captivity were the last survivors of the groups in which they were delivered or kept and have been maintained as individuals respectively at the Aquarium of Niagara Falls, for almost 20 years; the Shedd Aquarium, for 16 years; and the Pittsburgh Zoo, for 19 years and still alive at the time of this writing (1986). Another single animal lived over 17 years in Japan (Tobayama and Kamiya, this volume). The longevities of these individuals so greatly exceed those of the other captive *Inia* that we find it difficult, indeed, to merely attribute their success to the "survival of the medically fittest." We feel that there has been a significant number of other *Inia* kept in groups with excellent medical care and husbandry whose lifespans do not begin to approach those of the three animals cited above.

In addition to the incidence of overt aggression among *Inia,* a large male at Marineland of Florida was reported to steal, but not eat, food from a smaller male even though the smaller male tried to hide its fish. Obviously, sick individuals are placed at an even greater disadvantage when exposed to aggression or prevented from obtaining food. On the other hand, Johnson (1982) reported food sharing behavior by a male *Inia* toward a female who rejected the food at the Pittsburgh Zoo. This same large male was also reported to have fed a smaller male. Herald (1967) reported that a small male at the Steinhart Aquarium ate more heartily after another small male was introduced into its tank resulting in a desirable weight gain for both dolphins. Although more positive, these instances seem to be the exceptions rather than the rule relative to the keeping of groups of *Inia* in captivity. Best and da Silva (this volume) do report that, although most frequently observed to be a solitary feeder, *Inia* may join in apparently loosely organized groups to cooperatively herd food fish in the wild, but such cooperative behavior has not been observed in captives. While behavioral problems due to aggression have been reported for the marine Atlantic bottlenosed dolphin, *Tursiops truncatus* (Caldwell et al., 1968; Caldwell and Caldwell, 1977), we do not believe that they usually reach the degree or intensity of those seen in *Inia.*

Correlations between longevity and group sizes still require proper analysis but the general tendency is reflected in the following data from one institution:

Animals received in one shipment numbered five.
Animals dying in transport numbered one.
Animals dying within the first twenty-four hours numbered one.

Of the three remaining animals:

The first to die lived twelve months leaving two in the tank.
The second to die lived 32 months, leaving an isolated survivor.
After 41 months, the surviving dolphin was shipped to another institution while healthy and survived for an unknown length of time.

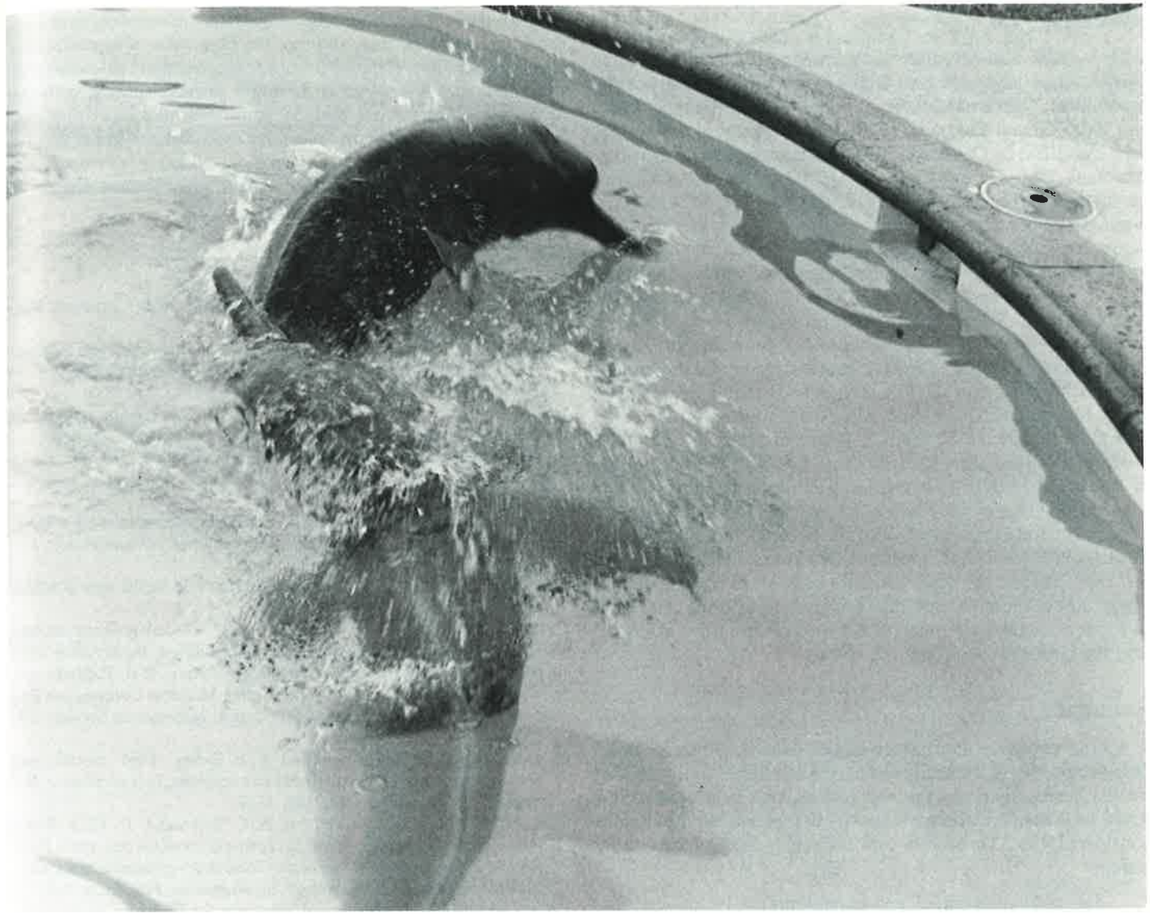

Figure 3. A small female *Inia geoffrensis,* newly introduced into a tank at Sea World in San Diego, California, is almost knocked out of the water by a larger, aggressive resident male. (Photograph by David K. Caldwell.)

Miscellaneous Behavior

In comparison to marine dolphins, *Inia geoffrensis* is a fairly lethargic species. It usually swims rather leisurely in its tanks as opposed to the high levels of activity commonly associated with *Tursiops truncatus.* This characteristic is reflected in its rate of food intake as well. Atlantic bottlenosed dolphins are known to consume about 15 pounds of fish per day compared to the 6–8 pounds of fish per day consumed by *Inia* (Table 1).

After a short period of acclimation, captive *Inia* have taken food from human hands quite readily. At least one institution took advantage of the situation and provided food fish for a price to tourists who were then allowed to feed the animals. Food for marine dolphins has been provided in this manner in several institutions based on the grounds that both tourists and animals enjoy the interactions and that the costs of food, as well as research programs in some cases, can be alleviated in this manner.

Inia will apparently play with objects placed in their tanks (Herald and Dempster, 1965; Klocek, 1981). Although Herald and Dempster (1965) report initial reactions of fear to novel objects placed in the tank, others have reported fearlessness in response to such events as the introduction of a strange hydrophone (Caldwell et al., 1966). At any rate, *Inia* habituate to novel objects and can be trained to perform relatively simple behaviors for the public, as was the case at the Fort Worth Zoological Park. Such behaviors were, however, limited by the physical abilities of the species.

On the other hand, sexual activity in *Inia* compares more closely with its marine counterparts. Such behavior includes a great deal of masturbation and both homosexual and heterosexual activity (Spotte, 1967), all of which can be quite active and lengthy in duration. There have been three births of *Inia* in captivity which include one stillbirth and another that lived only moments at the Fort Worth Zoological Park (Huffman, 1970; McCusker, 1973) and one live birth at Marineland of Florida in which the infant survived for two weeks (Caldwell and Caldwell, 1972).

Some captive *Inia* have demonstrated the frightening habit of resting (sleeping?) upside down at the bottoms of their pools (Caldwell et al., 1966; Herald, 1969). They were so immobile that they appeared to be dead. Observers that were unfamiliar with this kind of behavior often frantically notified the institution's staff whenever it was seen. Pilleri (1969) reported a similar death-like appearance for captive *Inia* that rested at the bottom on their bellies.

Research

Most of the research that has been conducted on *Inia* in the United States has focussed on their sound production and hearing capabilities. Their sounds were discussed by Caldwell et al. (1966) and Caldwell and Caldwell (1970). The anatomy of the eye has been examined by Dawson (1980) who compared *Inia* with other cetaceans. Harrison and Brownell (1971) studied the gonads of 18 of these captive dolphins, and Zam et al. (1970) reported internal parasitic trematodes and nematodes. Woodard et al. (1969) earlier reported pulmonary trematodiasis. Data based on behavioral observations have been contributed largely by the curatorial staffs of the various institutions in which *Inia* has been held and are invaluable. These same people have been instrumental in initiating investigations into disease related problems. Importers, aquaria, and oceanaria were very cooperative in making the carcasses of animals that died in their care available for scientific study. Skeletal materials, especially skulls, thus found their way into museums including the U.S. National Museum of Natural History in Washington, D.C.; the Los Angeles County Museum of Natural History in Los Angeles, California; the Florida State Museum in Gainesville, Florida; and the California Academy of Sciences in San Francisco, California. Skeletal materials are also in the collections of the American Museum of Natural History in New York and the Field Museum of Natural History in Chicago, Illinois. Systematic studies were initiated during the period in which so many individuals of the species were being imported into the United States (Caldwell, 1966).

Summary

A brief review of the history of the Amazon River dolphin, *Inia geoffrensis,* in captivity in the United States indicates that similar husbandry problems were encountered in at least six different facilities. The average longevity in captivity for the animals considered was 32.6 months and the major causes of mortality were:

1. Transportation (shock and pneumonia).
2. Stress and injury brought on as a result of aggressive behavior between individuals (see discussion below).
3. Skin problems, many arising from the bites and blows inflicted by other individuals or by the rigors of transport.
4. Pneumonia and an unusually high percentage of kidney problems as compared to that found in *Tursiops truncatus.*

The captive behavior of the animals at the six institutions providing data for this review, as well as animals not considered in Table 1, indicates a high level of lethargy unlike the captive behavior of the more familiar marine species. While it is apparent that *Inia* are trainable, they cannot accomplish the more complex and acrobatic behaviors commonly seen in such marine species as *Tursiops truncatus.*

Inia kept in groups may be very aggressive toward each other, particularly with respect to sexual behavior. In the Caldwells' experience sexual harassment by the largest males constituted a major problem in a social grouping of these dolphins. Sexual biting by a large, sexually mature male was a threat to even a large, mature female, and she had to be separated to prevent extensive damage by bites. This same mature male also was guilty of intensive aggressive behavior toward a juvenile male, cutting the latter badly. An immature male was aggressive in biting other animals and preventing a juvenile female from eating. Both male and female *Inia* attacked a recently-introduced small juvenile male, and a sick female was the subject of intensive sexual harassment by four males of assorted sizes until she could be separated. As this dolphin rarely occurs in groups of more than two individuals in the wild and most sightings are of solitary animals (Best and da Silva, this volume), the high rates of aggression in captivity possibly resulted from keeping animals in enclosures too small to allow them to maintain normal spacing between individuals. We suggest that no more than two individuals be kept in the same enclosure. Inasmuch as experience has suggested that it is very possible that antagonistic behavior may occur between two or more individuals, a fast and effective means of separating them should be provided.

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