Mar. Res. Indonesia Vol.37, No.2, 2012: 63−73

THE ELASMOBRANCH NURSERY AREA OF JAKARTA BAY

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Received: July 2011 Accepted: February 2012

ABSTRACT

A study on the correlation between water, sediment qualities and the diversity of elasmobranchs in Jakarta Bay has been conducted by the Research Center for Oceanography from the beginning of 2012. This paper presents a part of the study focusing on elasmobranch diversity and its size composition. Elasmobranchs in the coastal area of Jakarta Bay were collected using bottom gillnet every month to find out the species diversity and its size composition. The 162 collected individuals from Jakarta Bay were classified into eight species of rays and one whaler shark. *Himantura gerrardi, H. uarnacoides, H. walga* and *Neotrygon kuhlii* were the most common species found in this area. Interestingly, most specimens found in the area were immature and new born animals. This finding indicates that the coastal area of Jakarta Bay is one of nursery areas of most elasmobranchs living in adjacent waters although the bay has been heavily polluted.

Keywords*:* Elasmobranchs, Neonate, Juveniles, Jakarta Bay

INTRODUCTION

The subclass Elasmobranchii is a group of cartilaginous fishes that inhabit in all types of habitats, from freshwater to the deep ocean (Compagno, 2002; Last and Compagno, 2002). Some species are known to live in specific habitats and limited areas while others live in various habitats and are widely distributed. For instance, the fresh water whipray, *Himantura signifer*, exclusively lives in the freshwater, and several species of the genus *Glyphis* inhabit only in the river to estuary (Compagno et al., 2005, Last and Compagno, 2002). On the other hand, the bull shark *Carcharhinus leucas* is an amphidromous species and circumglobal in tropical and warm temperate waters, and the pelagic stingray *Pteroplatytrygon violoacea* lives in open ocean and is widely spread in all tropical waters (Compagno, 1984; Compagno et al., 2005; White et al., 2006). However, each elasmobranch species does not inhabit all types of habitats within its range, instead, they have prefer specific habitats during its life cycle (Simpendorfer and Heupel, 2004). Sharks and rays are known to use different habitats at different stages in their life cycle (Simpendorfer and Milward, 1993). The youngs are commonly segregated with adults to avoid predatory, and usually stay in the nursery area where adults do not normally inhabit in. Information on habitat preferences of elasmobranchs has been reported in publications (Klimley, 1987; Castro, 1993; Simpendorfer and Milward, 1993; Bonfil, 1997; Platell et al., 1998; Carlson, 1999; Compagno, 2001; Ebert and Cowley, 2003; Simpendorfer and Heupel, 2004; Compagno et al., 2005; Carraro and Gladstone, 2006), but those from Indonesian waters are not well documented.

Jakarta Bay is located north of Jakarta City. This area accumulates all wastes, both from industrial and domestic drainages, brought by three large rivers and many small ones which end into the bay. This area is also affected from other anthropogenic activities such as transportation and fisheries. There are a major shipping port and two large fishing ports along the coastal area contributing pressure to the coastal ecosystem of Jakarta Bay. Many reports showed the occurring on the degradation of the water quality due to

DOI : 10.14203/mri.v37i2.20

heavy metal contents, oil spills, organic and detergent contents (Arifin, 2004, 2008; Sari et al., 2010), which give consequences to the diversity of marine biota and human health (Burhanuddin et al., 1975; Aziz et al., 1980, 1998; Burhanuddin et al., 1980; Kastoro et al., 1997; Aziz, 2008; Djamali and Parino, 2008).

There was little information on the occurrence of elasmobranch fishes in Jakarta Bay. An intensive study on fish species diversity in Jakarta Bay in 1977 recorded eight species of rays in the area (Martosewojo et al., 1980). Another study conducted from 1977 to 1978 using bottom trawl in the same area, recorded 10 species of two batoid families (Burhanuddin et al., 1980). Two species of rays, *Dasyatis zugei* and *Himantura walga* (*Ampotistius imbricatus*?), were dominant among 10 elamobranch species caught in Jakarta Bay during the study (Burhanuddin et al., 1980; Djamali and Parino, 2008). There were also some records on new species of elasmobranchs from this area in the 19th century such as *Urolophus javanicus* (Martens, 1864) (see Last and Marshall, 2006), *Himantura polylepis* (Bleeker, 1852) (see Vidthayanon et al., 2011) and *Carcharias* (*Scoliodon*) *macrorhynchos* Bleeker, 1852 (see White et al., 2010). However, some of them may be already extinct due to the change of environmental condition and anthropogenic activities in this area (Last and Marshall, 2006; Vidthayanon et al., 2011). This paper reports the existing of elasmobranch species in coastal waters of Jakarta Bay and discusses the possibility of this area as nursery ground for some elasmobranch species.

MATERIALS AND METHODS

Elasmobranch fishes were captured monthly from March to October 2012 (except for June) as a part of studies on the anthropogenic impact on elasmobranch fishes in Jakarta Bay. Samples were taken using gillnets operated by eight fishing boats (8 m) in depths between 13 and 16 m. The length of gill nets varied from 250 to 1,000 m and the height is 2 m with stretched mesh sizes from 6 to 10 cm. Gillnets were set on the sandy mud substrates, about 2 to 4 km from the coast line for 4 to 6 hours.

Specimens were identified to species level using keys and descriptions in Last & Compagno (1999) and White et al. (2006). Disc width (DW) was measured for rays and total length (TL) for sharks to the nearest 1 mm using measuring tape for large specimens and 30 cm dial caliper for small specimens. Sex and maturity stages were also recorded and measured for each specimen. Size at sexual maturity was estimated by observing the calcification of claspers in males and the presence of eggs or embryos in the uterus of females. Birth size of each species was followed White et al. (2006) and Last et al. (2010). Neonate was determined by the presence of unhealed umbilical scar, while juvenile was determined for small individual with recently closed or healed umbilical scar (Castro, 1993; Bush, 2003; Garla et al., 2006; Yokota and Lessa, 2006).

RESULTS

A total of 162 elasmobranch specimens has been sampled, consisting of nine species of rays and one species of shark (Table 1). Three species of rays (i.e., *Himantura gerrardi, H. walga* and *Neotrygon kuhlii*) were found as the most common elasmobranch species in Jakarta Bay, followed by *Himantura uarnacoides* that was found in five occasions (March to August, exept for June) (Fig. 1).

Further, those three common species were abundant comparing to other species. *H. walga* was recorded as the most abundant species during the sampling period (29.4%), followed by *H. gerrardi* (28.2%) and *N. kuhlii* (21.5%). Although other species (*Taeniura lymma, H. uarnak, Aetobatus ocellatus, Aetomylaeus nichofii* and *Carcharhinus melanopterus*), were categorized as common species in Indonesia waters (White et al., 2006), only one or two specimens of those species were recorded during the study (Fig. 2).

A total of 46 specimens of whitespotted whipray, *H. gerrardi*, were caught throughout the sampling period. All specimens were young animals, while neonates represented about 60% of total species recorded (Fig. 3a). The smallest neonate was a male of 173 mm DW and the largest specimen caught from this location was a male juvenile measured 300 mm DW. The average size of *H. gerrardi* was not significantly different among months (F=4.96; P<0.05). The mean size was ranged from 175 to 195 mm DW (Fig. 3b).

Table 1. Size range of elasmobranchs caught in Jakarta Bay from March to October 2012 (except for June)

Species	Female		Male		Total
	Σ ind	Size (mm)	Σ ind	Size (mm)	
Carcharhinus melanopterus	1	531	-	-	1
Aetobatus ocellatus	2	757–923	1	492	3
Aetomylaeus nichofii	1	200	-	-	1
Dasyatis akajei	1	354	1	313	2
Himantura gerrardi	20	184–283	26	173–300	46
Himantura uarnacoides	11	253–455	11	230–365	22
Himantura uarnak	-	-	1	330	1
Himantura walga	16	153–210	31	115–212	47
Neotrygon kuhlii	16	164–380	19	160–300	35
Taeniura lymma	4	205–303	-	-	4
Total	72		90		162

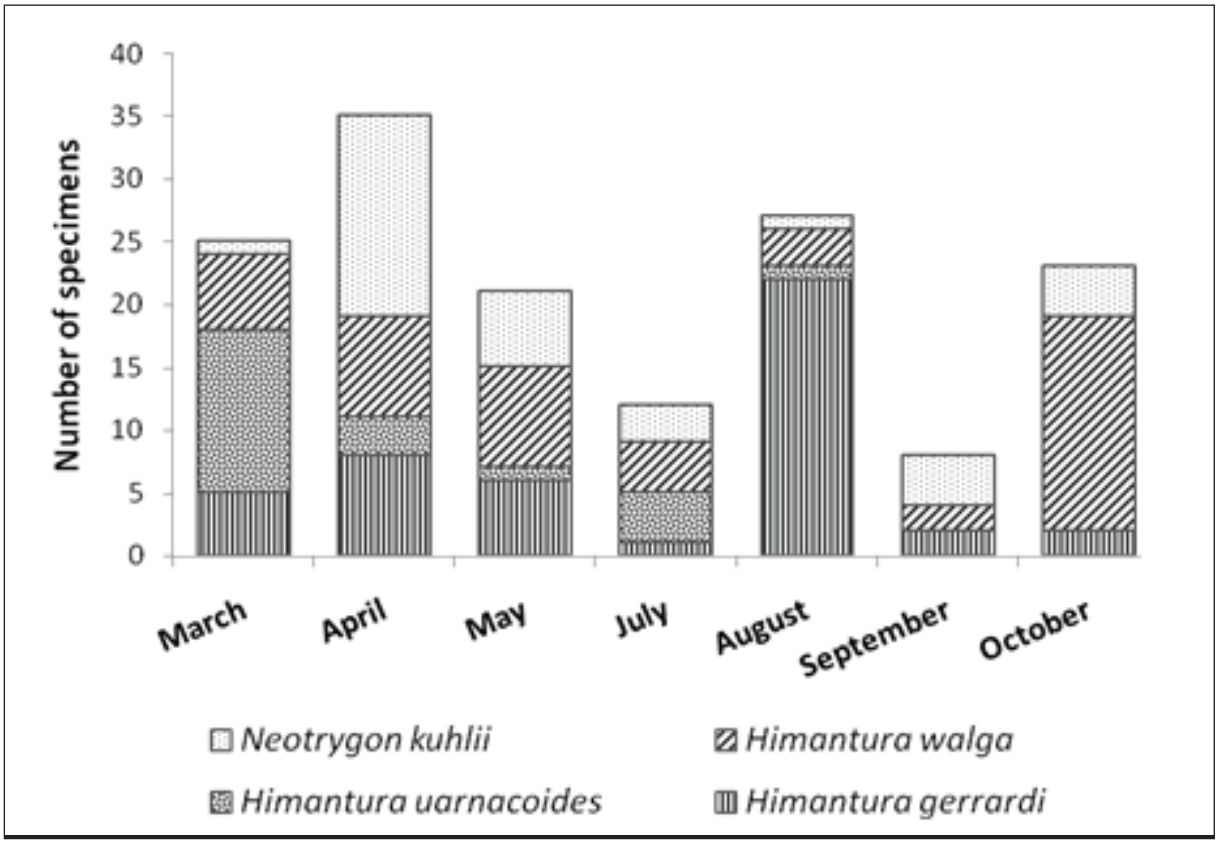

Figure 1. Occurrence of four elasmobranch species caught in monthly sampling from March to October 2012 (except for June).

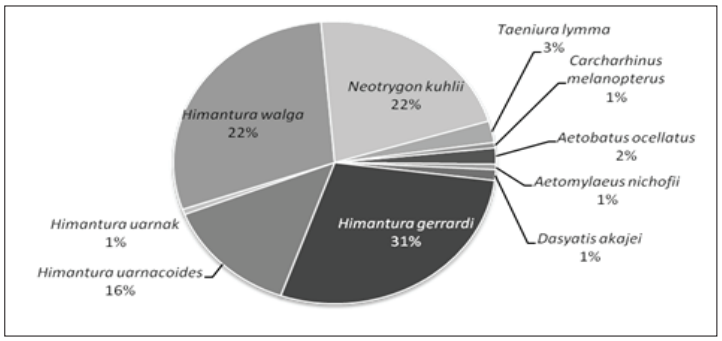

Figure 2. Species composition of elasmobranchs caught from Jakarta Bay from March to October 2012 (except for June).

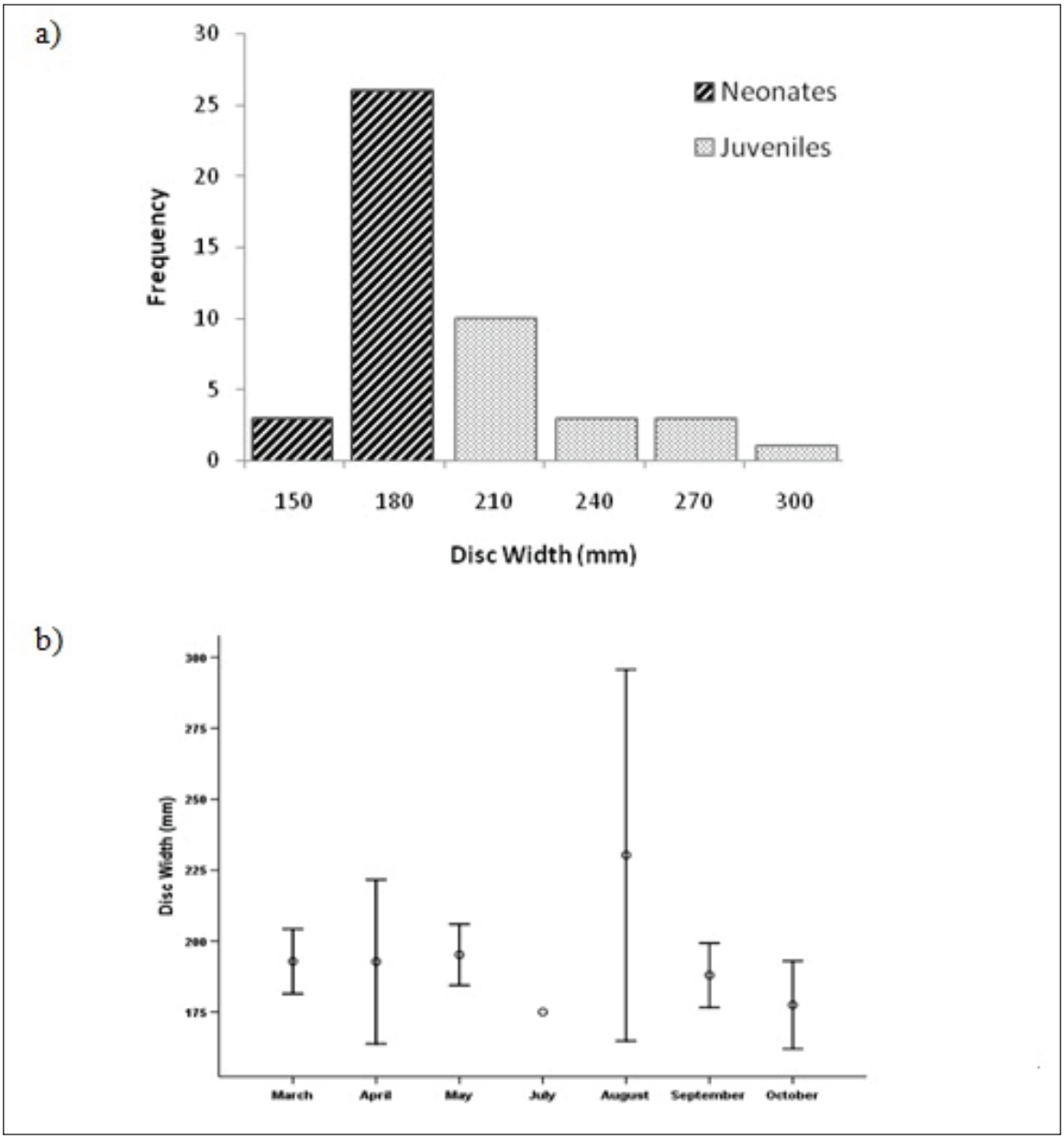

Figure 3. Size frequency of *Himantura gerrardi* caught from Jakarta Bay (a); and average size of the population, error bars showed standard deviations (b).

A total of 47specimens of the dwarf whipray, *H. walga,* were caught during the study, and most of them (83%) were adults. Neonate and subadults represented in small portions at 2% and 15%, respectively (Fig. 4a). The only neonate that was caught from this area in August, was a male (115 mm DW), while the largest adult specimen was a male (212 mm DW). Adults were caught throughout the sampling periods while subadults were collected in August, September and October. A post-partum female (207 mm DW) was also recorded in September. The average sizes of *H. walga* varied every month from 158 to 196 mm DW (Fig. 4b). However, the ANOVA test failed to detect the significant difference among months (F=3.08; P<0.05).

A total of 35 individuals of the bluespotted maskray, *Neotrygon kuhlii,* were caught in all stages from neonate to adult from March to October. Nine neonates, six juveniles, 12 subadults and eight adults were collected during the period (Fig. 5a). The smallest neonate recorded from this area was a male (160 mm DW) and the largest adult was a female (380 mm DW), and both specimens were collected in April. A 324 mm DW post-partum female was also recorded in September. Neonates

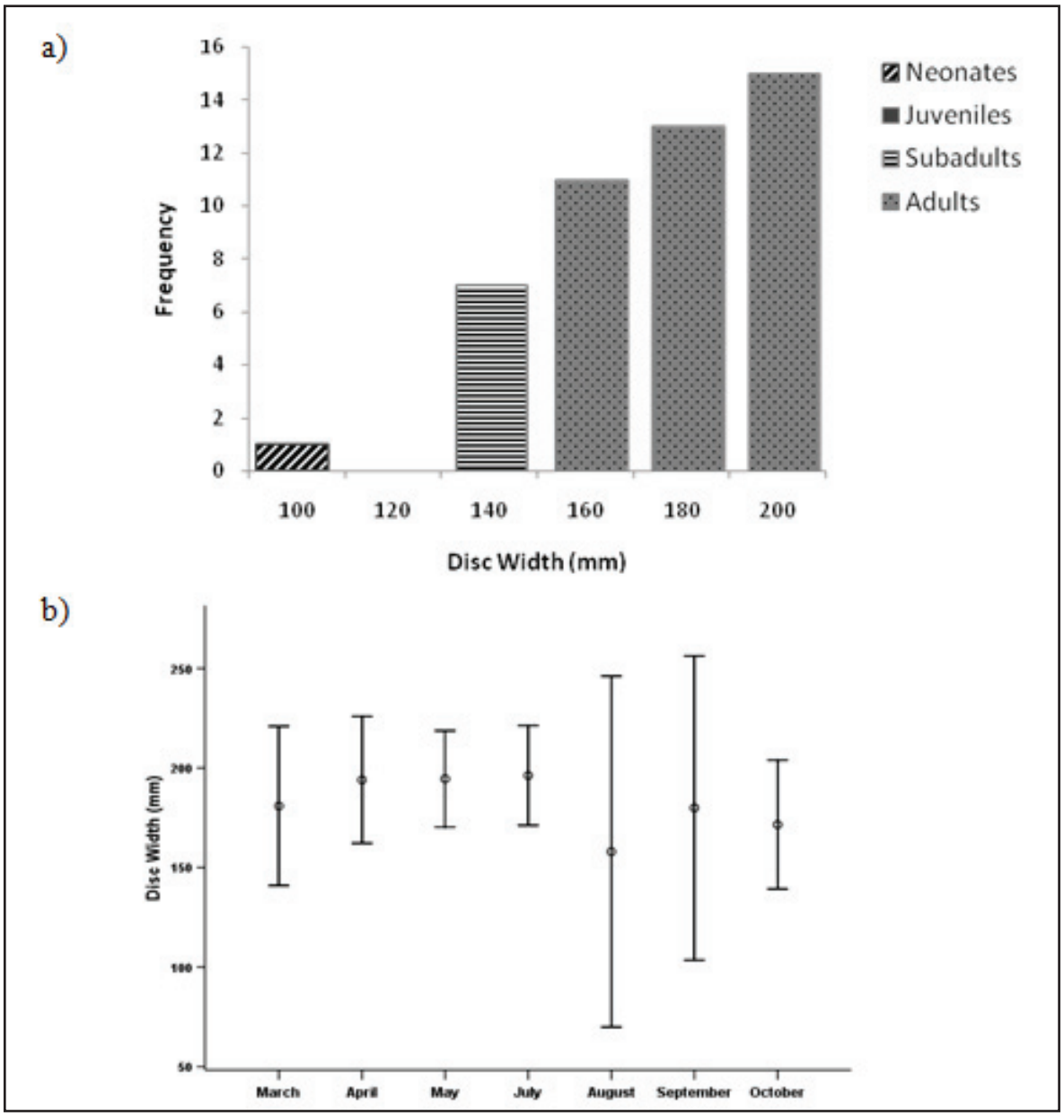

Figure 4. Size frequency of *Himantura walga* caught from Jakarta Bay (a); and average size of the population, error bars showed standard deviations (b).

and juveniles occurred in almost every month except March, while adults were found every month. The mean sizes of *N. kuhlii* varied every month from 164 to 323.2 mm DW. The ANOVA tests detected the mean sizes were significantly different among months (F=0.72; P>0.05). The differences of the average size of *N. kuhlii* were due to few data recorded in March (323.2 mm DW) and August (164 mm DW). The average sizes in other months were relatively similar, ranging from 196.3 to 236.8 mm DW (Fig. 5b).

The Bleeker's whipray, *H. uarnacoides,* was found only in the first five months during the sampling period. In 22 specimens collected from Jakarta Bay, almost all of them were neonates and juveniles (Fig. 6a). Neonates occupied about 77% and juveniles 18% of the collection. The only large specimen found during the study was a subadult female in 455 mm DW. Neonates occurred more in March but were represented monthly by only a single specimen in the following months. The smallest neonate recorded during the study was a male in 230.5 mm DW. There was a significant

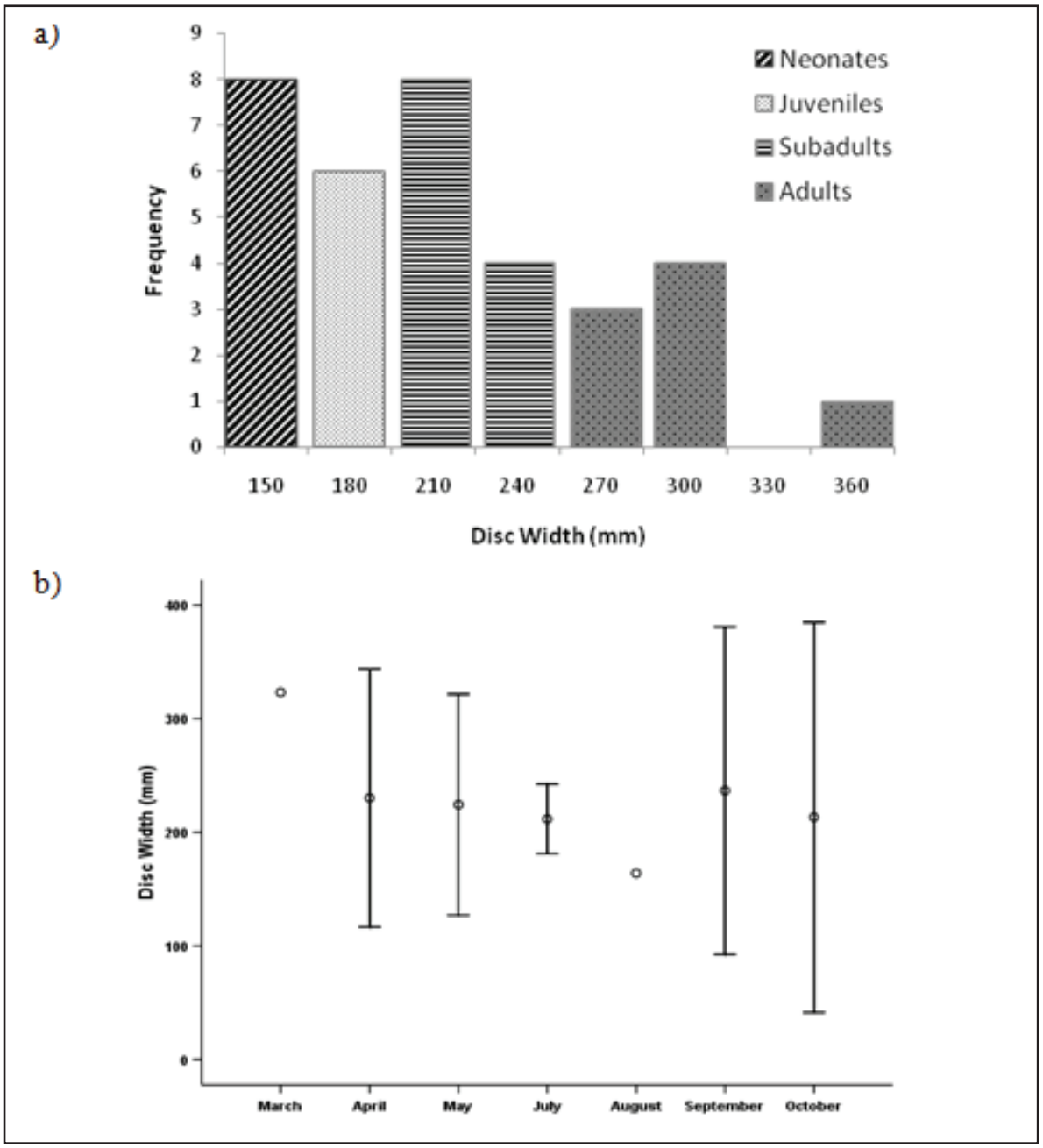

Figure 5. Size frequency of *Neotrygon kuhlii* caught from Jakarta Bay (a); and average size of the population, error bars showed standard deviations (b).

difference in the mean size of *H. uarnacoides* among months (F=1.86; P>0.05). The sizes varied from 274 to 359 mm DW; the lowest average was obtained from a single specimen recorded in May and the largest was recorded in April being influenced by the occurrence of a subadult (Fig. 6b).

Some neonates of other elasmobranch species were also recorded during the study. A male neonate of reticulate whipray, *Himantura uarnak,* was measured 330 mm DW. While the spotted eagle ray, *Aetobatus ocellatus,* was recorded in neonate and subadult stages. The neonate was a male (492 mm DW), recorded in May 2012. Another eagle ray species, *Aetomylaeus nichofii*, was also recorded as a new born female (200 mm DW). The only shark species recorded in Jakarta Bay during the study was also a neonate. A female blacktip reef shark, *Carcharhinus melanopterus*, was measured 531 mm TL. From 10 species of

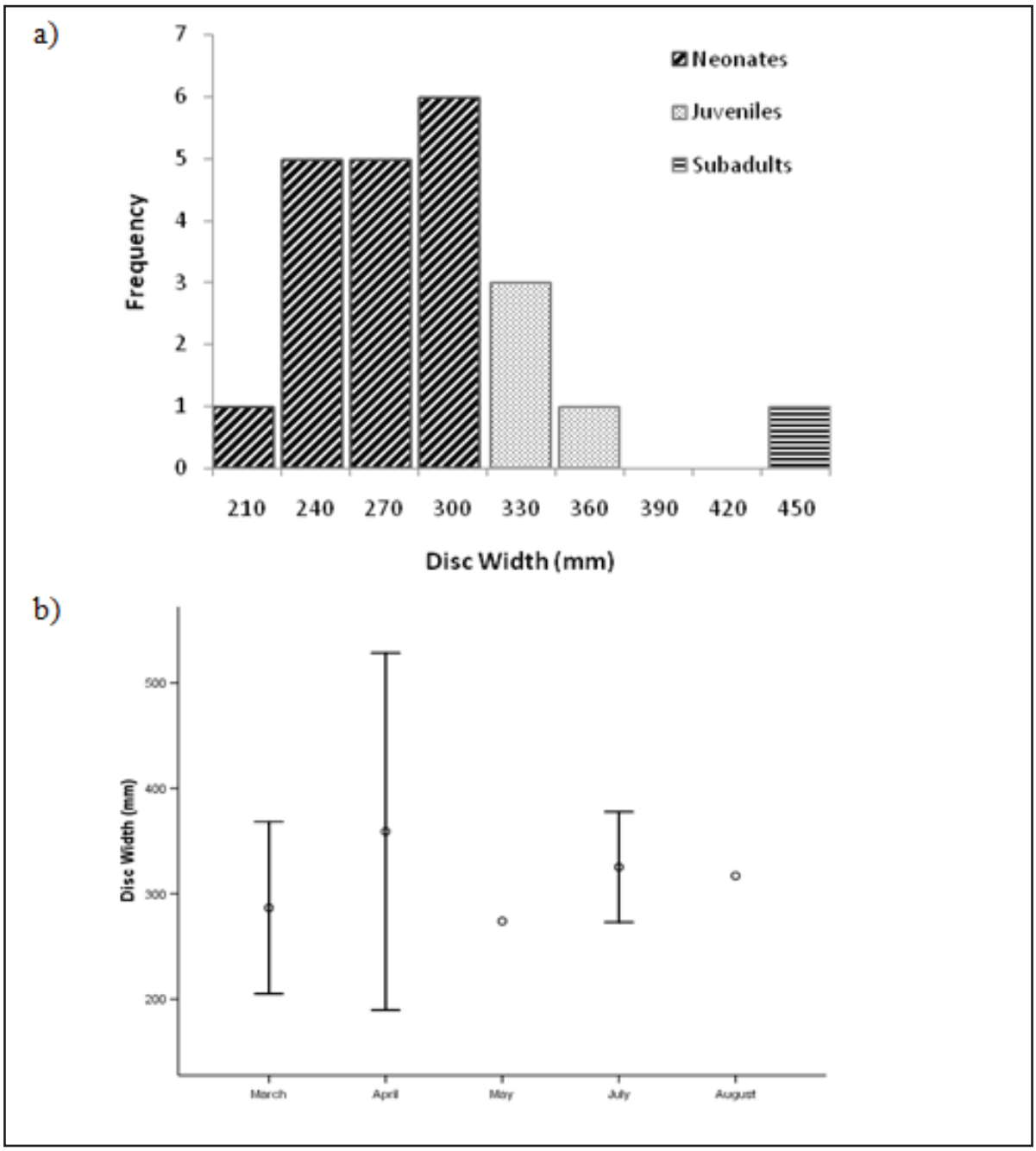

Figure 6. Size frequency of *Himantura uarnacoides* caught from Jakarta Bay (a); and average size the population, error bars showed standard deviations (b).

elasmobranchs recorded in Jakarta Bay, only two species that were not found in early stages. Three specimens of bluespotted fantail ray, *Taeniura lymma*, were recorded in adult sizes while two specimens of red stingray, *Dasyatis akajei,* were recorded in both subadult and adult sizes. Thus, 80% of 10 elasmobranch species caught in Jakarta Bay were considered to use this area as their nursery grounds.

DISCUSSION

The presence of neonates and juveniles of elasmobranch species in the Jakarta Bay demonstrated that this area was considered as a bearing and also nursery ground for elasmobranchs. Evidence of the coastal area utilized as nursery area for elasmobranch has been shown by many researchers (Springer, 1967; Branstetter, 1990; Castro, 1993; Simpendorfer and Milward, 1993; Carlson, 1999; Yokota and Lessa, 2006; Heupel et al., 2007). Even though Jakarta Bay is known as a polluted area due to the accumulation of heavy metals (Arifin, 2008), organochlorine pesticide (Munawir, 2010) and detergent contamination (Sari et al., 2010), the concentration of nutrients was also high (Muchtar, 2008) making this area eutrophic. An eutrophic waters can arise primary productivity, indicating that food is abundant in the given area. There is an assumption that nursery area for elasmobranchs is usually located in shallow waters, such as estuary and coastal marshes, with high production and having abundant supply of food (Castro, 1993; Heupel et al., 2007). Shallow and turbid waters are suggested as a preferable area for juveniles due to high productivity and low predatory risk (Clarke, 1971; Blaber and Blaber, 1980).

The nursery area is a place where the young can maintain the size of the population from juvenile mortality. Some studies showed that areas with low predation and food availability are the most appropriate places for young elasmobranchs as their nursery area (Branstetter, 1990; Castro, 1993; Simpendorfer and Milward, 1993; Heupel et al., 2007). Previously, nursery areas were divided into two types: primary nurseries are those where parturition occurs and the young live for a short time, while secondary nurseries are those where the juveniles occur after leaving the primary nursery and stay until they reach maturity (Bass, 1978). This division is supported by evidences on some carcharhinid and sphyrnid sharks (see Clarke, 1971; Gruber, 1988; Castro, 1993). Because those nursery definitions were rigorous and difficult to implement, Heupel et al. (2007) suggested that the elasmobranch nursery site is the area where elasmobranchs are commonly encountered; site fidelity of elasmobranchs to remain or be retained for extended periods; and the area that is repeatedly used every year.

Referring to the above criteria of Heupel et al. (2007), Jakarta Bay plays a role as a nursery area for most elasmobranch species occurring in this area. It was revealed in this study that the two species of dasyatids, *H. walga* and *N. kuhlii,* used the coastal area of Jakarta Bay as their habitat from young to adult stages without separation. The small size range between young and adults, and food preferences of those two species were more likely to be the reasons for non predatory on young by adults. *H. walga* and *N. kuhlii* primarily feed on crustaceans and small fishes (White et al., 2006; Last et al., 2010). Other elasmobranchs, such as *H. gerrardi, H. uarnacoides* and the black tip reef shark, *C. melanopterus*, tended to use Jakarta Bay as their bearing area. The fishing ground of adult *H. gerrardi* and *H. uarnacoides* caught by bottom longliners from Muara Angke Jakarta was the area between Muara Gembong and Indramayu (*pers. obs.*) in more than 20 m depth.

Large batoids, especially *H. gerrardi,* were also caught significantly as bycatch in the Danish seine fisheries operated in the Java Sea from Karimun Jawa to the Masalembo Islands. This species which occupied more than a half of the total elasmobranch volume caught by this fishing gear was in adult sizes between 400 and 600 mm DW (Fahmi et al., 2008). The occurrence of neonate *C. melanopterus,* as the only shark species found in the coastal of Jakarta Bay, was also evidence for the utilization of the area as nursery ground. This species is commonly found in lagoons and near the fringes of reefs; its size can reach 142 mm TL (Last et al., 2010). The gravid female of *C. melanopterus* possibly entered into Jakarta Bay from the reefs around the Seribu Islands to give birth. Castro (1993) showed that the blacktip shark, *C. limbatus* and the spinner

shark, *C. brevippina* give birth in coastal areas in South Carolina. Carlson (1999) also showed that the sandbar shark, *Carcharhinus plumbeus* gives birth in the coastal area of the northeastern Gulf of Mexico.

In the case of neonate and young of whitespotted eagle ray, *A. ocellatus*, in Jakarta Bay, indicated that the eagle ray utilized the coastal area as both primary and secondary nurseries if we used the definition of nursery following Bass (1978). A 923 mm DW young *A. ocellatus* was caught at the same time with neonate male in May 2012 and another young female was also recorded in September. Even though the individual number of this species was small, it seemed that the juveniles kept staying in the coastal area until they reached maturity. The similar pattern is also recognized in *A. ocellatus* in northeastern Brazil (Yokota and Lessa, 2006). Phenomenon of elasmobranch in Jakarta Bay in which neonates were recorded in the first half of the year and juveniles were recorded in the following half of the year indicated that the parturition occurred early of the year.

CONCLUSION

The coastal area of Jakarta Bay has been proven as nursery for elasmobranchs living in the Java Sea and the adjacent areas, such as batoids and small sharks. The relatively low water quality of this area is not a limiting factor for elasmobranchs to give birth and spend their early stages in the area. The adaptation capability of some elasmobranch species, especially for batoids, to live in shallow and murky waters is an advantage to prevent predation and maintain their populations. However, the intensive fishing activities and reclamation in the coastal area could seriously threatened to the sustainability of elasmobranch population in Jakarta Bay.

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