

**Catch per unit effort (CPUE) and fishing gear standardization  
for kawakawa (*Euthynnus affinis*) fishery in Bali Province**

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**ABSTRACT**

Tunas are very important fish species for marine fisheries in Indonesia. Besides large tunas, another important catch for fishermen in Bali province is neritic tuna include kawakawa (*Euthynnus affinis*). Kawakawa is the dominant catch with almost 50% of total neritic tuna catch. The objectives of this study were to investigate the catch per unit effort (CPUE) and fishing gear standardization of kawakawa fishery in Bali province. Data were collected from fishery statistics of Bali province from 2004 to 2010. Data analyses were using catch per unit effort (CPUE) and fishing power index (FPI) methods. The highest catch was recorded in 2007 around of 7,342 ton which caught by gill net while the highest catch per unit effort (CPUE) recorded in 2009 with 5.44 ton/unit using purse seine. Based on fishing power index (FPI) calculation, purse seine was the standardized fishing gear to catch kawakawa with the highest average catch of 2.83 ton/unit. This result gives recommendation for fishermen to use purse seine for optimizing the catch of kawakawa.

**KEYWORDS: kawakawa, Bali province, CPUE, FPI**

**INTRODUCTION**

All types of tuna are an important resource for countries in Southeast Asia (including Indonesia), both as a source of income as well as a source of protein for the people. Reduced oceanic tuna resources caused by the high fishing pressure resulted several numbers of fishermen to switch their target species to neritic tuna which also has economic value which is relatively high prices offered by the fish processing company. Some of neritic tuna in Southeast Asia are longtail tuna (*Thunnus tonggol*), frigate tuna (*Auxis thazard*), bullet tuna (*Auxis rochei*) and kawakawa/eastern little tuna (*Euthynnus affinis*) (SEAFDEC, 2013).

In Indonesia, production of kawakawa is the highest among other neritic tuna from 2001 to 2010. During that time, the production of neritic tuna was 1,007,176 ton and the highest

composition was kawakawa with 35.5%, followed by the combination of frigate tuna and bullet tuna with 33% and longtail tuna with 31.5% (FAO, 2013). One of kawakawa production in Indonesia obtained from Bali Province which dominated by small scale fisheries (Agency for Marine and Fisheries of Bali Province, 2011).

There are still little information on the fishing aspects and the utilization of kawakawa in Bali Province. One of tools to estimate the abundance of fish species is catch per unit effort (CPUE) method. Besides indicating the abundance of fish stock, catch and effort data are relatively easy to collect (Quinn & Deriso, 1999 in Battaile & Quinn, 2004). This study conducted to analyze the fishing aspect such as catch, effort, catch per unit effort (CPUE) and fishing gear standardization of kawakawa fishery in Bali Province. The information obtained would be beneficial contribution to develop appropriate neritic tuna (kawakawa) management in Bali Province.

## METHODS

Data were collected from Annual Fishery Statistics of Bali Province from 2003 to 2010. Collected data were annual catch and effort data for kawakawa. There are three main Regency of small scale fisheries for kawakawa, which are Karangasem, Buleleng and Jembrana (Figure 1). Fishing gears used to catch kawakawa in Bali Province are purse seine, gill nets, troll lines and hand lines.



**Figure 1.** Three main Regency of small scale fisheries for kawakawa, *E. affinis*, in Bali Province (Karangasem, Buleleng and Jembrana).

Catch and effort data were analyzed to calculate catch per unit effort (CPUE) per year using formula (Gunarso & Wiyono, 1994):

$$CPUE = \frac{Ci}{Ei}$$

where *CPUE* is catch per unit effort (tonnes/unit), *Ci* is catch in year *i* (tonnes), *Ei* is effort in year *i* (trip).

Kawakawa resources were caught using several types of fishing gear. Therefore, it should be standardized into certain gear. This gear must have the highest catch rate or productivity among gears. The purpose of gear standardization is to equalize the fishing effort of kawakawa fishery. This is important because each gear has a different perception. Standardization conducted by finding the value of power indices of capture (Fishing Power Index/FPI) of each gear (Gunarso & Wiyono, 1994):

$$FPI_i = \frac{CPUE_i}{CPUE_s}$$

where *FPI<sub>i</sub>* is fishing power index of specific fishing gear, *CPUE<sub>i</sub>* is catch per unit effort from fishing gear to be standardized, *CPUE<sub>s</sub>* is catch per unit effort from standardized fishing gear.

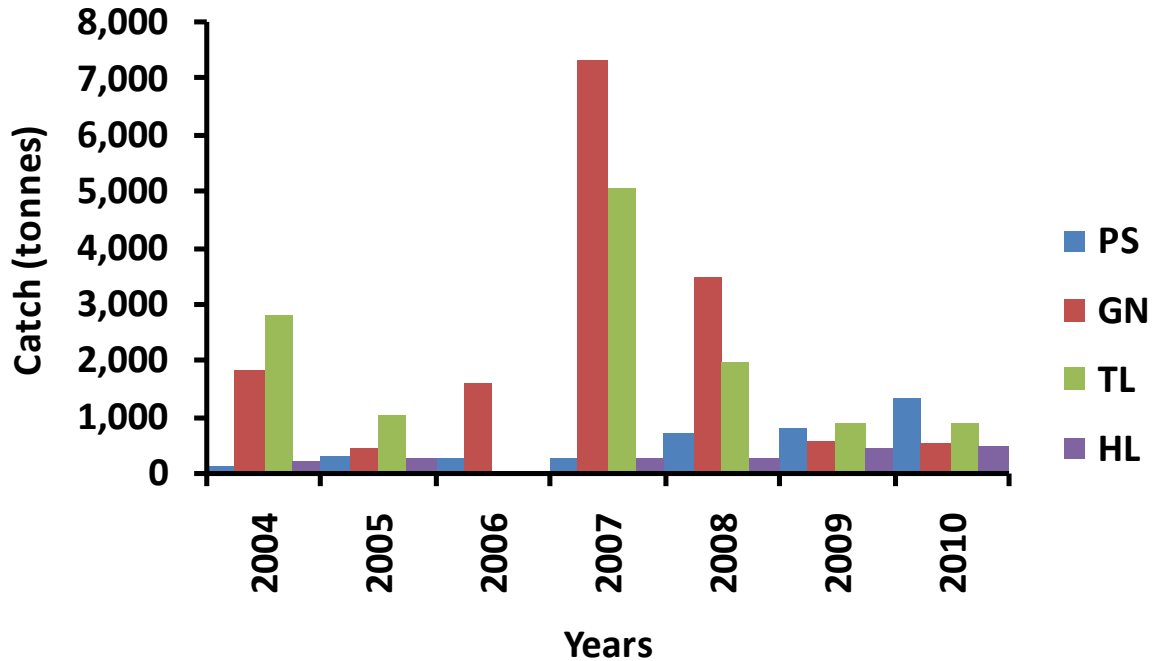
Then continued with determine standardized fishing gear (effort):

$$f_s = \sum_{i=1}^n FPI_i \times f_i$$

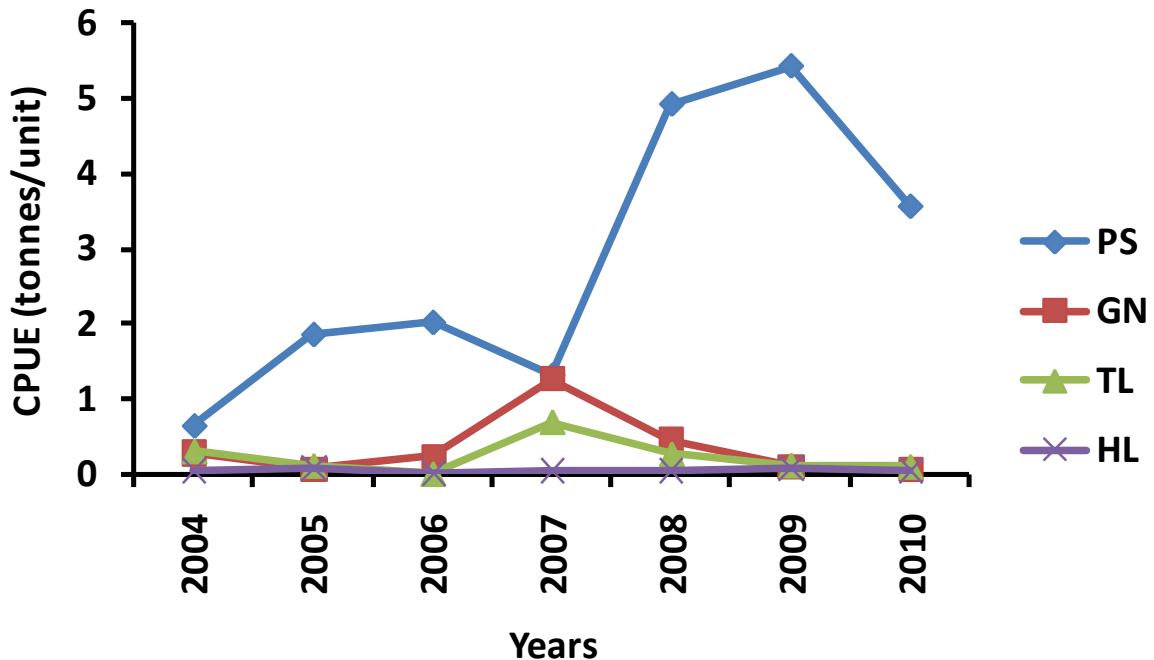
where *f<sub>s</sub>* is standardized effort (unit) and *f<sub>i</sub>* is effort (fishing gear) to be standardized (unit).

## RESULTS AND DISCUSSION

In Bali Province, kawakawa was caught using four different fishing gears which are purse seine (PS), gill nets (GN), troll lines (TL) and hand lines (HL). The highest catch occurred in 2007 using gill nets with 7,342 tonnes (Figure 2). However, the highest catch per unit effort appeared in 2009 with 5.4 tonnes/unit using purse seine (Figure 3). It does can be occurred because of the highest catch in 2007 also utilize high effort of many gill nets. While in 2009, eventhough there was smaller catch, the CPUE value can be high because it's operate fewer effort of purse seine.

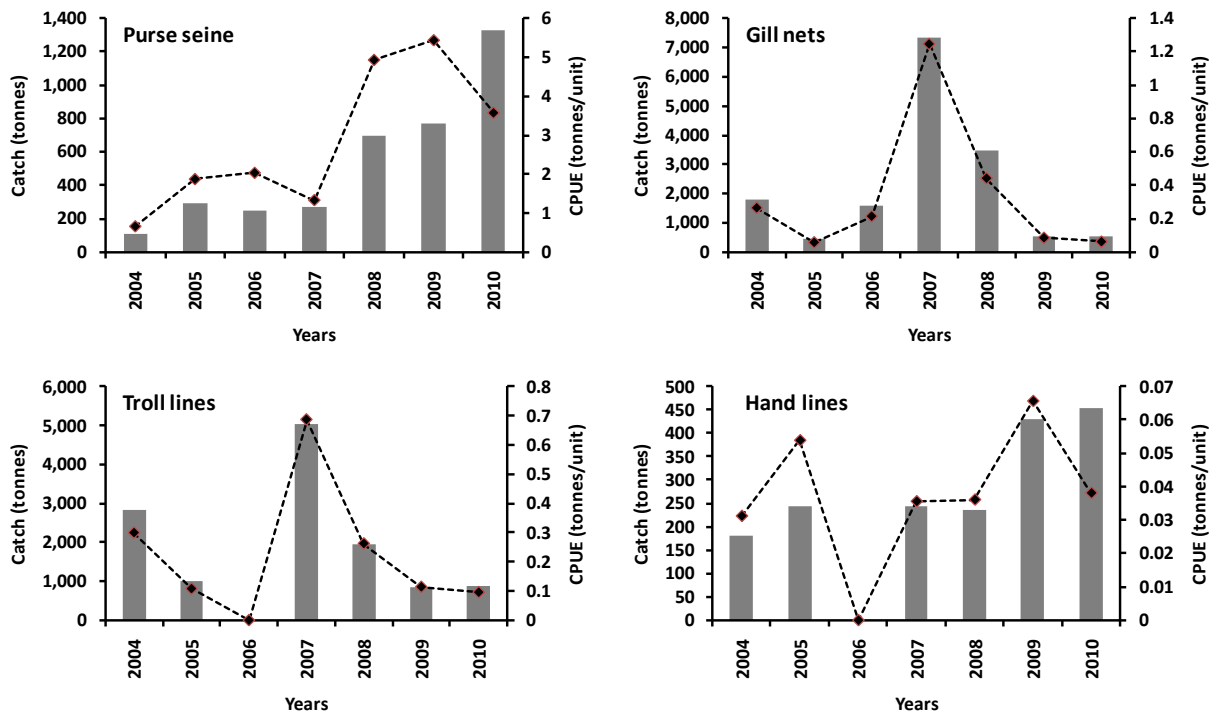


**Figure 2.** Catch of kawakawa (*E. affinis*) from Bali Province using purse seine (PS), gill nets (GN), troll lines (TL) and hand lines (HL) from 2004 to 2010.



**Figure 3.** Catch per unit effort (CPUE) of kawakawa (*E. affinis*) using four different fishing gears from 2004 to 2010.

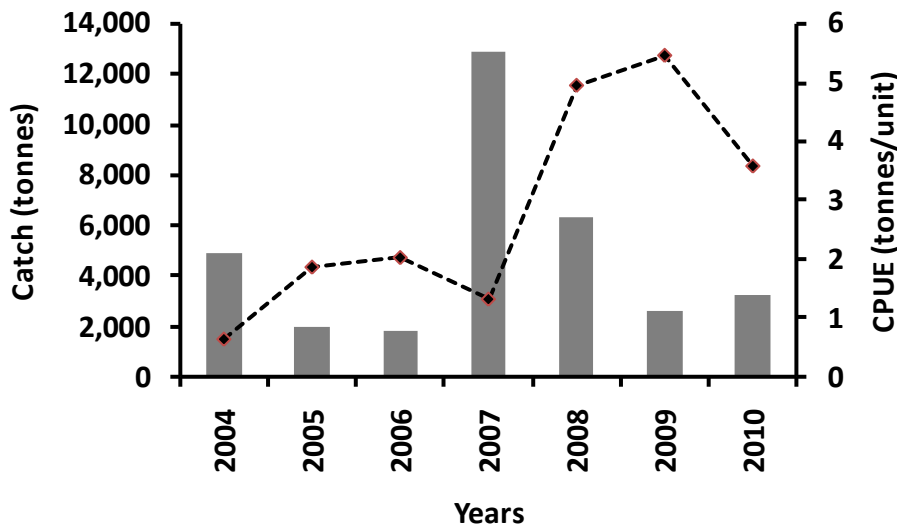
Catch per unit effort (CPUE) of kawakawa tends to increase with the highest value in 2009 with 5.44 tonnes/unit. While CPUE of kawakawa for other gears were fluctuated and subject to decrease with the highest value occurred in 2007 for gill nets (1.25 tonnes/unit) and troll lines (0.69 tonnes/unit) and in 2009 for hand lines (0.07 tonnes/unit) (Figure 4). CPUE for each gear then standardized using standardized gear that has the highest average of CPUE. The highest CPUE for kawakawa is purse seine with 2.83 tonnes/unit (Table 1). After standardization, the highest catch occurred in 2007 with nearly 13,000 tonnes. However, the CPUE is low because of the standardized effort in 2007 was relatively high compare to that in other years. On the contrary, catch in 2009 just around 2,000 tonnes but the highest CPUE was the highest due to a small unit of standardized effort on that year. Furthermore, the pattern of CPUE from standardized effort resemble with CPUE from purse seine (Figure 5).



**Figure 4.** Catch and Catch per unit effort (CPUE) of kawakawa (*Euthynnus affinis*) using four different fishing gears separately.

**Table 1.** Fishing gear standardization for kawakawa (*Euthynnus affinis*) in Bali Province.

Years	Purse seine			Gill nets			Troll lines			Hand lines		
	CPUE	FPI	f s	CPUE	FPI	f s	CPUE	FPI	f s	CPUE	FPI	f s
2004	0.65	1	174	0.26	0.41	2788	0.30	0.46	4378	0.03	0.05	281
2005	1.86	1	158	0.05	0.03	237	0.11	0.06	536	0.05	0.03	131
2006	2.02	1	122	0.21	0.10	786	0.00	0.00	0	0.00	0.00	0
2007	1.32	1	203	1.25	0.95	5556	0.69	0.52	3814	0.04	0.03	184
2008	4.93	1	141	0.44	0.09	704	0.26	0.05	393	0.04	0.01	48
2009	5.44	1	141	0.08	0.01	104	0.11	0.02	158	0.07	0.01	79
2010	3.57	1	371	0.06	0.02	151	0.10	0.03	250	0.04	0.01	127
Average CPUE (tonnes/unit)	2.83			0.34			0.22			0.04		

**Figure 5.** Catch and Catch per unit effort (CPUE) of kawakawa (*Euthynnus affinis*) using standardized gear.

Catch per unit effort (CPUE) is one of indicator to determine the status of fisheries resources. The increase of CPUE of kawakawa in Bali Province, with standardized purse seine fishing gear, indicates that exploitation rate is in the developing stage. Based on fishing power index (FPI) calculation, purse seine was the standardized fishing gear to catch kawakawa with the highest average catch of 2.83 tonnes/unit. According to Herrera and Pierre (2009), purse seine is one of the importance gear to catch neritic tunas, including kawakawa, in Indonesia and other South East Asian countries. This result gives recommendation for fishermen to use purse seine for optimizing the catch of kawakawa.

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