

DISTRIBUTION OF ECOLOGICALLY RELATED SPECIES IN THE ATLANTIC OCEAN: SIGHTING BY TAIWANESE TUNA LONGLINE FISHING VESSELS FROM 2004 TO 2008

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SUMMARY

From 2004 to 2008, the data of 85 trips, 7,652 observation days of Taiwanese tuna longline fishing vessels were used to analyze the distribution of ecologically related species. More than 50 species were recorded, including 36 species of seabirds, 5 species of sea turtles and 8 species of cetaceans. Most of the sea turtles and cetaceans were recorded in tropical area, including olive ridley, leatherback turtle, pantropical spotted dolphin and bottlenose dolphins. Only a few loggerhead and whales were present in temperate waters. Sea birds were distributed in the entire Atlantic Ocean with different species composition by area. Northern fulmar, black-legged kittiwake, and great shearwater were shown in the northern Atlantic Ocean. Shearwaters, boobies, terns, storm-petrels, gulls and gannets were abundant in tropical areas. Eight species of albatrosses and petrels were distributed in the southern area. To avoid the incidental catch of those species, all Taiwanese vessels operating south of 20°S are required to set bird scaring lines and other mitigation measures. The continuing collection of data could provide information for conservation purposes.

RÉSUMÉ

Entre 2004 et 2008, les données de 85 sorties, 7.652 jours d'observation de palangriers thoniers du Taipei chinois ont été utilisées pour analyser la distribution des espèces écologiquement voisines. Plus de 50 espèces ont été enregistrées, dont 36 espèces d'oiseaux de mer, cinq espèces de tortues marines et huit espèces de cétacés. La plupart des tortues marines et des cétacés ont été signalés dans les régions tropicales, y compris la tortue olivâtre, la tortue luth, le dauphin tacheté pantropical et le grand dauphin. Seules quelques tortues couannes et baleines étaient présentes dans les eaux tempérées. Les oiseaux de mer étaient distribués dans l'ensemble de l'océan Atlantique, présentant une composition spécifique différente par zone. Le fulmar boréal, la mouette tridactyle et le puffin majeur ont été signalés dans le Nord de l'océan Atlantique. Les puffins, fous, sternes, océanites, goélands et fous de Bassan abondaient dans les régions tropicales. Huit espèces d'albatros et de pétrels étaient réparties dans le Sud. Afin d'éviter les captures accidentelles de ces espèces, tous les navires du Taipei chinois opérant au Sud de 20°S sont tenus de s'équiper de dispositifs d'effarouchement des oiseaux et d'autres mesures d'atténuation. La poursuite de la collecte des données pourrait fournir des informations à des fins de conservation.

RESUMEN

Desde 2004 a 2008, se utilizaron los datos de 85 mareas, 7.652 días de observación de los palangreros atuneros taiwaneses, para analizar la distribución de especies ecológicamente relacionadas. Se consignaron más de 50 especies, incluyendo 36 especies de aves marinas, 5 especies de tortugas marinas y 8 especies de cetáceos. La mayoría de las tortugas marinas y los cetáceos se consignaron en el área tropical, e incluían tortuga golfina, tortuga laúd, delfín moteado y delfín mular. En aguas templadas sólo estaban presentes algunas tortugas bobas y ballenas. Las aves marinas se distribuían en todo el océano Atlántico, con una composición por especies por área diferente. El fulmar del Norte, la gaviota tridáctila, y el petrel corona negra estaban presentes en el Atlántico septentrional. Pardelas, piqueros, gaviotines, petreles de la tormenta, gaviotas y alcatracas abundaban en zonas tropicales. Ocho especies de albatros y petreles se distribuían en la zona meridional. Para evitar la captura incidental de estas especies, todos los buques taiwaneses que operan al Sur de 20°S deben calar líneas espantapájaros y disponer de otras medidas de mitigación. La recopilación continua de datos podría proporcionar información para fines de conservación.

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KEYWORDS

Bycatch, observer, tuna longline, Taiwan, seabirds, sea turtles, cetaceans

1. Introduction

By the early 1990s, incidental catch of ecologically related species, included the marine mammals, sea birds, and sea turtles, have become issues of global attention (Hall et al., 2000; Lewison et al., 2004; Moore et al., 2009). Fisheries bycatch has been implicated in population declines of several species of sea turtles and seabirds (Baker and Wise, 2005; Brothers, 1991; Lewison et al., 2004; Rogan and Mackey, 2007; Tuck et al., 2001). For conserving those species and minimizing the impact from longline fisheries, ICCAT urges member countries to provide information and take mitigation measures to reduce the bycatch. ICCAT Resolution 03-11 on Sea Turtles to encourage Contracting Parties, Cooperating non-Contracting Parties, Entities or Fishing Entities (CPCs) to collect and provide sea turtles bycatch data. As for seabirds, Recommendation 07-07 by ICCAT on Reducing Incidental By-catch Of Seabirds in Longline Fisheries requests CPCs to collect and provide all available information on interactions with seabirds, including incidental catches by their fishing vessels.

Taiwan started to fish tuna and tuna-like species in the Atlantic Ocean since early 1960s. During those days, the fishery targeted on albacore and yellowfin, and ever since the development of deep-longline operations in the late 1980s in the tropical Atlantic Ocean, some of the fishing efforts were shifted to target mainly on bigeye. Albacore, bigeye and yellowfin constituted of more than four fifth of the annual catch in the recent years. Bigeye and yellowfin are mainly caught in the area between 15°N and 15°S. Higher composition of albacore has been observed in the area north of 15°N and in the area south of 15°S. Swordfish and sharks are mainly bycatch species to the fishery. The number of vessels in the longline fishery has declined from 176 in 2002 to 109 in 2008; the average number of fishing vessels was 111. The distribution of fishing efforts was showed in Fig. 1.

It is important to evaluate the impact of fisheries across large ocean regions regarding the wide distribution of marine megafauna and fisheries (Lewison, 2005). Understanding the scale of bycatch and its impacts on the ecosystem could help us to assess the stock status and manage bycatch (Alverson et al., 1994; Pauly et al., 2002). Taiwan launched a pilot observers program on distant water fisheries since 2002. In line with the government's policy in establishing an observers program on a global basis, and availability of budgets to support the increase of observers, the number of observers employed gradually increased and reached 62 in 2008 and remained in the level. The bycatch information in the Atlantic Ocean have preliminary analyzed for bycatch of seabirds (Chang et al., 2008; Huang et al., 2009; Huang et al., 2009b; Huang, 2010; . The objective of this paper is to provide the sighting record for distribution information on ecologically related species.

2. Material and Methods

Sighting data were collected from the observers onboard. For each set, observers record basic information of the vessels, daily fishing activities (which included fishing position (latitude and longitude), number of hooks, time of set and hauling, using bird-scaring equipment or not, bait types), catch information (the number and weight of catch), ecologically related species information (the species and numbers of sighted during fishing operation, incidental catch number, species and status (live/dead)) (Huang *et al.*, 2009b).

Training materials and illustrated handbooks are provided for seabirds and other bycatch species. The sightings were done in daylight. The observation was conducted at the stern of the vessel to estimate the number of birds, sea turtles, and cetaceans swimming around the vessel. From the top of the deck that provided a 10-170 degree vision, censuses were drawn. For those individuals cannot be immediately identified, digital photographs were taken for experts to identify the species.

3. Results

3.1 Fishing area and observation

A total of 85 observer trips were deployed in the Atlantic Ocean from June 2004 to March 2008, Total of 7,652 fishing days were recorded, with the total efforts of 25,316 thousand hooks. The average observer days for a trip

were 90 days. The detail information was listed in **Table 1**. The observation areas are showed in Fig. 2. We separated the fishing grounds to three areas, which are the tropical area (TAL, 15°N-15°S) for bigeye tuna fishing vessels, north area (NAT, north of 15°N) and south area (SAT, south of 15°S) for albacore fishing vessels. Around 75% of the observation area was in the tropical areas, with only 15% in south area and the remaining in north area. The observation areas have covered sixty percent area by 5*5 degree grids.

3.2 Sea birds distribution at sea

All sighted ecologically species distributions were showed in Fig. 3. At least thirty-six species of seabird sighted were listed in **Table 2**. A total of 42 thousand seabirds were counted. The highest number of sighted birds was 300 in a given day during the day time. Among these species, great shearwaters were widespread throughout the year. Other species were in limited areas.

Three species, Northern fulmar (*Fulmarus glacialis*), Black-legged Kittiwake (*Rissa tridactyla*) and Great shearwater (*Puffinus gravis*) were most abundant in the northern Atlantic Ocean.

In tropical area, Leach's Storm-Petrel (*Oceanodroma leucorhoa*), Arctic Tern (*Sterna paradisaea*), Brown Booby (*Sula leucogaster*), Common Tern (*Sterna hirundo*), Cory's Shearwater (Cory's Shearwater), Gannet, Great Shearwater (*Puffinus gravis*), Leach's Storm-Petrel (*Oceanodroma leucorhoa*), Lesser Frigatebird (*Fregata ariel*), Long-tailed Jaeger (*Stercorarius longicaudus*), Wilson's Storm-Petrel (*Oceanites oceanicus*), Madeiran Storm-petrel (*Oceanodroma castro*), Masked Booby (*Sula dactylatra*), Red-footed Booby (*Sula sula*), and Sabine's Gull (*Xema sabini*) were distributed.

Cape petrel (*Daption capense*), Tristan Albatross (*Diomedea dabbenena*), Southern Royal Albatross (*Diomedea epomophora*), Wandering Albatross (*Diomedea exulans*), Northern Royal Albatross (*Diomedea sanfordi*), Sooty Albatross (*Phoebastria fusca*), Light-mantled Sooty Albatross (*Phoebastria palpebrata*), Yellow-nosed Albatross (*Thalassarche chlororhynchos*), Black-browed Albatross (*Thalassarche melanophrys*), White-chinned Petrel (*Procellaria aequinoctialis*), Spectacled Petrel (*Procellaria conspicillata*), Southern Giant Petrel (*Macronectes giganteus*) took place in the southern area. Among these species, Spectacled Petrels were showed in the southwest Atlantic Ocean, and most of the others were sighted in the southeast Atlantic Ocean.

3.3 Sea turtles distribution at sea

Five species, 148 sea turtles have sighted, most were concentrated in tropical areas (n=139). The major species were leatherback turtles (*Dermochelys coriacea*, n=85). And Olive Ridley turtles (*Lepidochelys olivacea*) are only showed in tropical areas and Gulf of Guinea. Some loggerhead turtles are sighted in the southeast and southwest Atlantic Ocean, near to south Africa and South America.

3.4 Cetaceans distribution at sea

At least eight species, around five thousand (n=5161) cetacean were recorded; most were distributed in tropical areas (n=4984). Bottle nose dolphin (*Tursiops truncatus*) was the most frequently sighted cetacean and was widely distributed more inshore. Pantropical spotted dolphin (*Stenella attenuata*) and spinner dolphin (*Stenella longirostris*) were abundant and found mainly in tropical areas and Guinea Bay. Blackfish and some whales were recorded in small numbers.

4. Discussion

Thirty seven species seabirds and likely four species would be incidentally caught in ICCAT fisheries (Anon, 2008). Among them, this study notes eight species of albatross and other seven species include petrel and shearwater. Most species sighted in tropical area were least concern species in IUCN redlist (**Table 2**); and due to the different forage behavior of tropical seabirds, some boobies and terns do not follow the ships or feed on discards (Blaber et al., 1995, Blaber et al., 1998), resulting in low bycatch rate and mortality compared with albatross in temperate areas. Because albatross will track fishing vessels for the baits, there is possibility for them to be incidental catch by fishing vessels. Most of the endangered species were distributed in the south of 20S. Some species of albatross and giant petrels were bycatch (Huang *et al.*, 2009a).

Due to most of the ecological related species were sighted from far distance, some species could not be identified. Retaining all seabirds killed and returning carcasses would be helpful for identification (Baker et al., 2007).

Considering it would be difficult for distant water fishing vessels to keep the carcasses for extended periods of time, digital photographs are better options than returning severed heads to port for identification. Further photographs work better with cataloguing samples. Images of dorsal and ventral surfaces, especially underwing pattern, are crucial for identifying many seabird species. A high-resolution digital camera would also be useful for identification.

To summarize, this paper provide seabirds/sea turtles/cetacean distribution encountered with fisheries in the Atlantic Ocean, provides hotspots for conservation priority. Fishermen do not want to incidental catch those ecological species. More international research would be helpful for seabirds and fishery sustainability. Therefore cooperation between seabird conservation groups and fishermen would result in a win-win situation.

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Table 1. Number of vessels observed, observed sets and hooks in Atlantic Ocean.

<i>Year</i>	<i>Trips</i>	<i>Days</i>	<i>1000 Hooks</i>
2004	7	622	2,271
2005	6	510	1,741
2006	18	3178	10,387
2007	31	1843	6,780
2008	23	1499	4,137
Total	85	7652	25,316

Table 2. Ecological related species sighted.

	<i>Sighted species</i>	<i>Scientific Name</i>	<i>IUCN Status</i> ¹	<i>Sighted area</i>		
				<i>North</i>	<i>Tropic</i>	<i>South</i>
Seabirds	Northern Fulmar	<i>Fulmarus glacialis</i>	LC	V		
	Black-legged Kittiwake	<i>Rissa tridactyla</i>	LC	V		
	Great Shearwater	<i>Puffinus gravis</i>	LC	V	V	
	White-faced storm- petrel	<i>Pelagodroma marina</i>	LC	V		
	Cory's Shearwater	<i>Calonectris diomedea</i>	LC		V	
	Lesser Frigatebird	<i>Fregata ariel</i>	LC		V	
	Wilson's Storm-petrel	<i>Oceanites oceanicus</i>	LC		V	
	Madeiran Storm-Petrel	<i>Oceanodroma castro</i>	LC		V	
	Leach's Storm-Petrel	<i>Oceanodroma leucorhoa</i>	LC		V	
	Long-tailed Jaeger	<i>Stercorarius longicaudus</i>	LC		V	
	Common Tern	<i>Sterna hirundo</i>	LC		V	
	Arctic Tern	<i>Sterna paradisaea</i>	LC		V	
	Masked Booby	<i>Sula dactylatra</i>	LC		V	
	Brown Booby	<i>Sula leucogaster</i>	LC		V	
	Red-footed Booby	<i>Sula sula</i>	LC		V	
	Sabine's Gull	<i>Xema sabini</i>	LC		V	
	Gannet	Genus <i>Morus</i>			V	
	Brown Noddy	<i>Anous stolidus</i>	LC		V	
	Cattle egret	<i>Bubulcus ibis</i>	LC		V	
	Great Frigatebird	<i>Fregata minor</i>	LC		V	
	Kelp gull	<i>Larus dominicanus</i>	LC		V	
	Red-billed gull	<i>Larus scopulinus</i>	LC		V	
	Red-billed tropicbird	<i>Phaethon aethereus</i>	LC		V	
	White-tail tropicbird	<i>Phaethon lepturus</i>	LC		V	
	Tristan Albatross	<i>Diomedea dabbenena</i>	CR			V
	Southern Royal Albatross	<i>Diomedea epomophora</i>	VU			V
	Wandering Albatross	<i>Diomedea exulans</i>	VU			V
	Northern Royal Albatross	<i>Diomedea sanfordi</i>	EN			V
	Sooty Albatross	<i>Phoebetria fusca</i>	EN			V
	Light-mantled Albatross	<i>Phoebetria palpebrata</i>	NT			V
	Atlantic Yellow-nosed Albatross	<i>Thalassarche chlororhynchos</i>	EN			V
	Black-browed Albatross	<i>Thalassarche melanophrys</i>	EN			V
	White-chinned Petrel	<i>Procellaria aequinoctialis</i>	VU			V
Spectacled Petrel	<i>Procellaria conspicillata</i>	VU			V	
Cape petrel	<i>Daption capense</i>	LC			V	
Southern Giant Petrel	<i>Macronectes giganteus</i>	LC			V	
Sea turtles	Loggerhead turtle	<i>Caretta caretta</i>	EN	V	V	
	Green turtle	<i>Chelonia mydas</i>	EN		V	
	Leatherback turtle	<i>Dermochelys coriacea</i>	CR		V	
	Hawksbill Turtle	<i>Eretmochelys imbricata</i>	CR		V	
	Olive Ridley turtle	<i>Lepidochelys olivacea</i>	VU	V	V	
Cetaceans	Spinner dolphin	<i>Stenella longirostris</i>	DD		V	
	Pantropical spotted dolphin	<i>Stenella attenuata</i>	LC		V	
	Rough-toothed dolphin	<i>Steno bredanensis</i>	LC		V	
	Common Dolphin	<i>Delphinus delphis</i>	LC		V	
	Black fish	Family <i>Delphinidae</i>			V	
	Bottle nose dolphin	<i>Tursiops truncatus</i>	LC		V	
	False killer whale	<i>Pseudorca crassidens</i>	DD		V	V
	Killer whale	<i>Orcinus orca</i>	DD			V

Note: 1.IUCN statuses downloaded from www.redlist.org on April 29, 2010.

2. Seabirds Population estimations downloaded from <http://www.birdlife.org/datazone/species/index.html> on April 29, 2010.

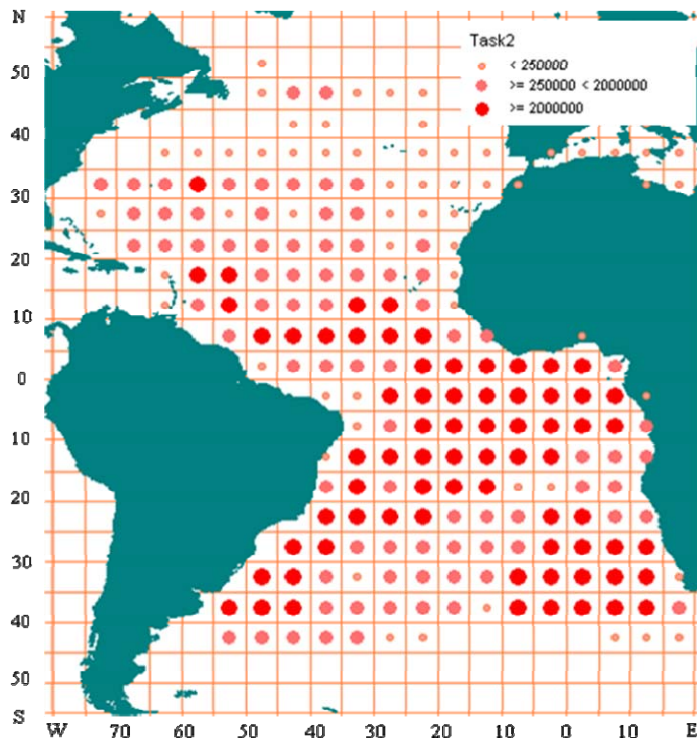


Figure 1. Distribution of all Taiwanese fleets in the Atlantic Ocean from 2004 to 2008.

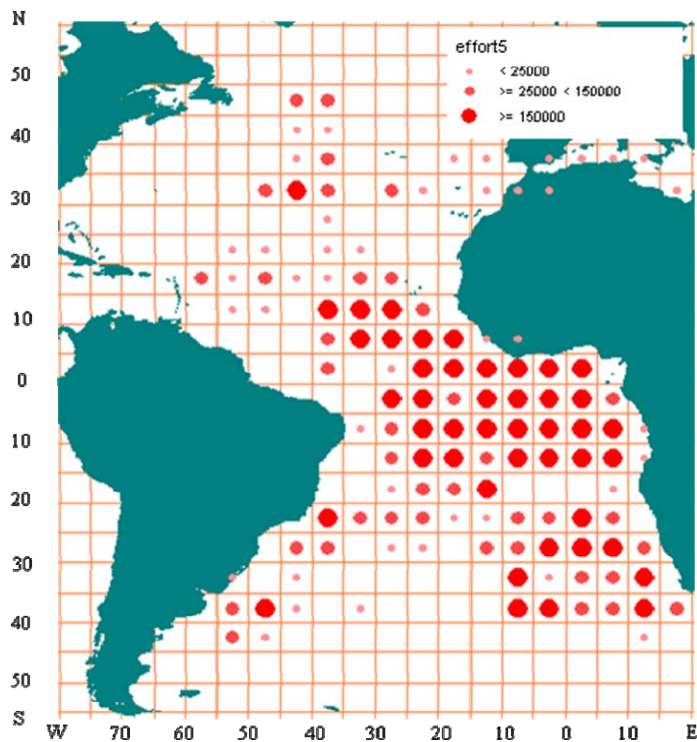


Figure 2. Distribution of observed fishing effort from 2004 to 2008

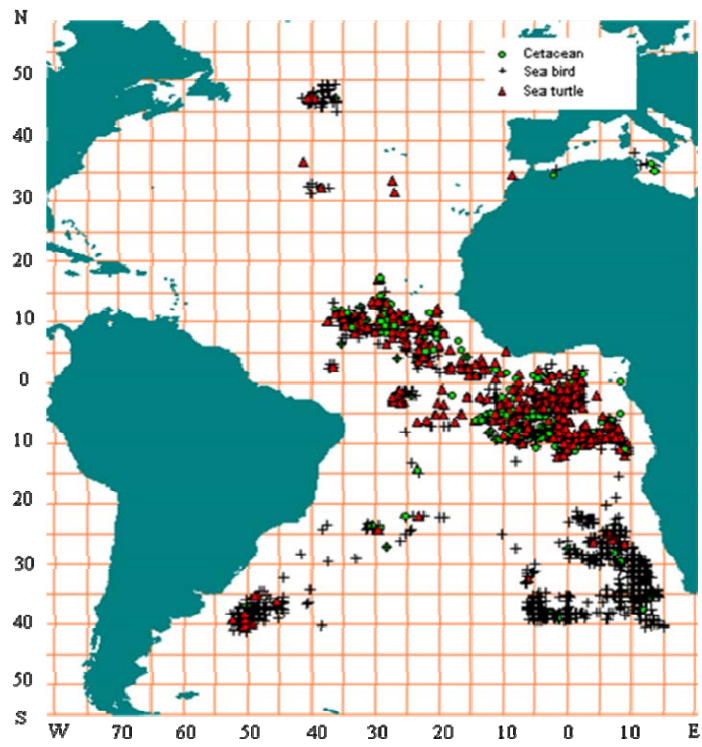


Figure 3. Distribution of sighted ecological related species from 2004 to 2008.