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RESPONSE

Incidental catch of seabirds: strengthening observer programs and increasing cooperation

H.-W. Huang[1] & Y.-M. Yeh[2]

1 Institute of Marine Affairs and Resource Management, Center of Excellence for the Oceans, National Taiwan Ocean University, Keelung, Taiwan

2 Department of Tourism Management & Institute of Tourism Management, Nanhua University. Chiayi, Taiwan

Correspondence

Hsiang-Wen Huang, Institute of Marine Affairs and Resource Management, Center of Excellence for the Oceans, National Taiwan Ocean University, Keelung 202, Taiwan

Email: julia@ntou.edu.tw

Since the 1990s, the incidental catch of seabirds in commercial marine fishing operations has generated a great deal of attention (Croxall *et al*., 2012). Its impact is not only on seabird populations but also on fisheries. Much research has been carried out to estimate the number of seabirds caught incidentally, with the hope of identifying mitigation measures to reduce incidental catch (Gilman, Brothers & Kobayashi, 2005; Anderson *et al*., 2011). As mentioned in Phillips (2013), longline fisheries are considered one of the major fisheries that have negative impacts on seabirds, especially for albatross in the Southern Ocean (Anderson *et al*., 2011). An evaluation of the entire situation in the three oceans would be an important area for research and follow-up conservation measures (Lewison *et al*., 2004). To date, there is limited bycatch information from Asian longline fleets. It is hoped that our research can contribute to filling this data gap, especially in the Atlantic Ocean.

Strengthening observer programs

Despite limited coverage, observer programs are an important bycatch data collection system (Sha, 2013). There are two major challenges for observer programs. First, observer coverage rate is an issue (Lewison, 2013; Phillips, 2013). Many researchers have pointed out that 5% coverage is inadequate to truly estimate mortality rates. Higher observer coverage can improve data credibility and decrease the uncertainty and variation. However, observer programs are expensive and difficult to implement, particularly for distant water fishing fleets. To achieve the current 5% level, the annual budget for the Taiwanese longline observer program was over US$2 million per year (Huang, 2011). Despite this limitation, our study aimed to identify appropriate methodology to analyze observer data and provide sampling strategy.

Second, all three commentaries in response to our paper also highlight the importance of data quality, and particularly the importance of species-specific data collection (Lewison, 2013; Phillips, 2013; Sha, 2013). Through observer training, seabird species identification was improved. However, long working periods at sea (ranging from 3 to 6 months), heavy work load and a difficult working environment meant that it was difficult to retain experienced observers for a long time. Better species identification materials, such as a 'key' system and workshops for fisheries observers might be helpful. The seabird species identification protocol developed by Japan and Birdlife International is welcome and can provide a way forward (Inoue, Yokawa & Minami, 2012).

International cooperation

Improving international cooperation on seabird conservation is another issue of high importance if we are to successfully address this conservation challenge. Phillips (2013) mentions the trend of seabird population decline in the southern Atlantic Ocean and suggests that ecological risk analysis has not provided sufficient information, highlighting the importance of long-term monitoring of the seabirds/albatross population, as well as tuna stocks. Although a limited number of seabird experts from fishing countries provided observer data for the International Commission for the Conservation of Atlantic Tunas (ICCAT) ecological risk analysis on seabird in 2008, it is encouraging to see more countries, including Japan, participate in ecosystem-related meetings in recent years (ICCAT, 2012). However, seabirds are not a target species for conservation by ICCAT. The Agreement on Conservation of Albatross and Petrels (ACAP) only takes note of data from related countries but does not adopt mandatory conservation measures, not to mention that Taiwan could not even participate in ACAP. Considering the global aspect of the issue of seabird conservation, we think an appropriate international cooperation system or forum is necessary.

Cooperation between scientists and fishermen

Phillips (2013) suggests that fishermen might be reluctant to adopt operational practices that may be inconvenient, or have safety or financial implications, without conclusive

proof that fisheries are responsible for the decline of seabird populations. We reiterate the importance of cooperation between researchers and fishermen in establishing and implementing mitigation measures. Through positive and close cooperation between Japanese fishermen and scientists, Melvin, Guy & Sato (2011) were able to provide safe and more effective mitigation measures which could be accepted by fishermen. This demonstrates the value of close cooperation and understanding between fishermen and scientists in the development of mitigation measures.

There are many possible reasons for limited incidental catch data from Asian fleets, such as the cost of the observer program and limited effort and training on the collection of bycatch data. Limited bycatch data might result in over-interpretation and lack of precision in estimating mortality (Wallace *et al*., 2010; Sha, 2013). For example, in Taiwan, data from observers on the incidental catch of seabirds and sea turtles were scarce before 2005. With increased awareness of the importance of seabird populations and the marine ecosystem, a great deal of research on the estimation of seabird bycatch has been conducted worldwide, with the exception of the Atlantic Ocean (Huang & Liu, 2010; Huang, 2011; Huang & Yeh, 2011). We hope that our analysis can contribute to the scientific basis for further conservation work.

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