

Does by-catch pose a threat to seabirds in the Ionian Sea (Eastern Mediterranean)? A quantitative research of local fisheries

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Introduction

Numerous studies worldwide have demonstrated that incidental catches (by-catch) of seabirds in fishing gears potentially pose a considerable risk to their populations. However, the available data on seabird by-catch in the Eastern Mediterranean are still patchy and insufficient to determine the rates of seabird by-catch and its impact on seabird populations. The present study was carried out as part of the LIFE07/NAT/GR/000285 project titled as "Concrete conservation actions for Mediterranean Shag and Audouin's Gull in Greece including the inventory of relevant Marine IBAs". It attempts to improve our understanding of patterns of seabird incidental catches and species affected by by-catch in the Ionian Sea and more specifically in the Prefecture of Zakynthos Island, as well as to identify the main types of fishing gear responsible for it and to estimate its impacts on local populations of seabird species listed in Annex I of the EU Bird's Directive.

Methods

The data were collected through a questionnaire-based survey which was conducted in collaboration with the Fishery Department of the Prefecture of Zakynthos from July to December 2010. The questionnaire was distributed to local fishermen and was consisted of closed and open-ended questions. The method used was based on personal interviews with fishermen and the obtained data were analysed in a time-spatial scale. The collected fishery data included, fishery characteristics, types of fishing gear used, fishing months per gear type, marine fishing areas, average fishing days per month, average daily fishing effort (number of hooks per days for longlines and meters of nets for nets). The data related to seabird by-catch included main by-catch seasons (i.e. spring, summer, autumn and winter) and marine areas as well as average annual number of seabirds caught per seabird species per type of fishing gear. The annual fishing effort for each fishery gear type was estimated from identified fishing months, average fishing days per month and mean daily fishing effort. For fisheries which use more than one type of gear during particular month, the proportion of fishing days were equally weighted for each type of gear (i.e. if a particular fishery is using both nets and bottom longlines during a particular month and the average number of fishing days is 20, then 10 fishing days are attributed to nets and 10 to bottom longlines). Seasonal fishing effort was estimated by adding up the monthly fishing effort for the respective months. Fishing areas for each fishery were identified on maps using 10x10 nautical mile grid.

The average number of birds incidentally caught per unit effort (per 1000 hooks and km of longlines and nets, respectively) was initially estimated by dividing the annual by-catch with the annual fishing effort. It has been observed that seabird by-catch rates vary significantly among seasons, therefore seasonal by-catch rates were estimated for each species. Data for the type of fishery gear from the estimated seasonal fishing effort and incidental mortality seasons per type of fishing gear, were provided by the fishermen. In order to acquire a rough estimation of seasonal by-catch rates, it was assumed that, for each fishery, by-catch rates are the same during all seasons when incidental catches occur. Following this way, estimation of by-catch rates takes into account the variations in fishing efforts and fishing areas among fisheries. The estimate of seasonal by-catch rates per species per fishing type were acquired by averaging the seasonal by-catch rates over all fisheries. The accuracy of the estimation is limited due to the fact that fishermen could not provide information on the total number of seabirds caught per season.

Results

Fishing effort

According to EU Fleet Register there are 189 fishing licenses issued on Zakynthos. The present questionnaire study covered almost 79% of the local registered piscatorial fleet (150). The main fishing gears used by these fisheries surveyed were nets, bottom longlines (BLL) and surface longlines (SLL) with an estimated overall annual fishing effort 31,420,897 m of nets (total annual average length of nets per fishery operation: 225,312 m), 5,902,030 bottom longline hooks (annual average number of hooks per fishery operation: 42,158 hooks) and 602,048 surface longline hooks (annual average number of hooks per fishery operation: 13,088 hooks). The average number of fishing days per month was 15.3 days. The main fishing areas were located primarily in the coastal regions of Zakynthos Island and nearby islands (Kefalonia, Echinades, Ithaki, Strofadia) (Figures 1,3,5,7). Estimated seasonal fishing efforts are provided in Table 1.

By-catch rates

Incidental catches of seabirds occurred mainly in the coastal regions of Zakynthos Island, the southern coastal area of Kefalonia Island and the marine area around Strofades (Figures 2,4,6,8). The initial estimation of by-catch rates was based on the total annual fishing effort and the total number of accidentally trapped birds per type of fishing gear per species. The results (Table 2) indicate that Cory's Shearwater are most susceptible to incidental mortality, primarily in bottom longlines (by-catch rate 0.0626 birds/1000 hooks) and surface longlines (bycatch rate 0.06976 birds/1000 hooks). Mediterranean Shags have also been reported to be caught in bottom longlines (by-catch rate 0.00071 birds/1000 hooks) and nets (by-catch rate 0.00003 birds/km nets).

By-catch patterns were further elaborated by estimation of seasonal by-catch rates per species per gear type. Only Mediterranean Shag has been recorded to be caught in nets. Low number of caught birds resulted in low seasonal by-catch rates varying between (0.00003 birds/km of nets). By-catch in nets has been recorded to occur during spring and summer (Table 3).

Bottom longlines have been identified as a main type of fishing gear responsible for seabird by-catch. It is estimated that 351 Cory's Shearwater are caught annually by the surveyed fisheries. The main by-catch seasons are spring and summer with by-catch rates up to 0.061 and 0.153 birds/1000hooks, respectively, however by-catch occurs also during autumn and winter months. In addition Mediterranean Shags are caught in bottom longlines during spring and summer with by-catch rates (0.00017 and 0.0042 birds/1000hooks, respectively) (Table 4).

Among all seabird species only the Cory's Shearwater has been recorded to be caught in surface longlines. By-catch occurs primarily in summer (0.375 birds/1000 hooks) and to a lesser extent during spring (0.0365 birds/1000 hooks) (Table 5).

Conclusions

Questionnaires for fishermen have proven to be a useful tool for the assessment of seabird by-catch. Prior experience in onboard surveys of seabird by-catch which scarcely record seabird incidents due to costly and limited sampling¹, can be efficiently complemented by questionnaires.

Longlines, namely bottom longlines but also surface longlines have been identified as the main types of fishing gear causing seabird by-catch mortality. The five (5) most abundant seabird species in the Southern Ionian Sea, are Cory's Shearwater, Mediterranean Shag, Yellow-legged Gull, Audouin's Gull and Yelkouan Shearwater. All of these species have been identified to be implicated in incidental catches in fishing gear in the Eastern Mediterranean², however, only the first two species have been recorded to be caught in significant numbers in the Southern Ionian Sea.

By extrapolating the by-catch rates to all 189 fisheries registered in Zakynthos Prefecture, the estimated annual incidental mortality of 6.3 Mediterranean Shags in bottom longlines and nets represents approximately 3.0-5.1% of the 31-53 pairs breeding in Southern and Central Ionian Sea³.

Similarly, estimated 495 Cory's Shearwater caught in longlines represents 1.7-2.0% of the local population of the Cory's Shearwater which is estimated about 5,000-6,000 breeding pairs⁴. Although by-catch of Cory's Shearwaters during pre-breeding period in spring may affect birds which migrate via Southern Ionian Sea to the Aegean Sea, the highest by-catch rates occur during summer months, when it can be assumed that the caught birds were originated from the colonies in the Southern Ionian Sea.

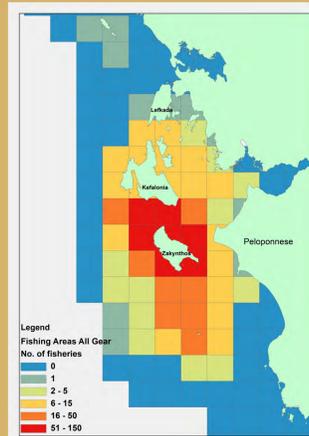


Figure 1. Fishing areas for all fishing gear

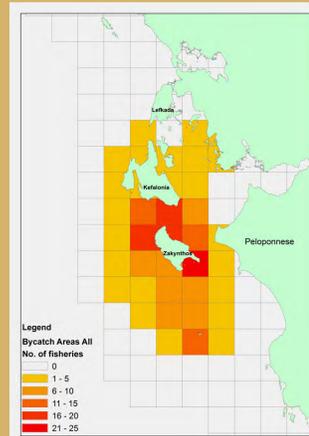


Figure 2. By-catch areas for all fishing gear

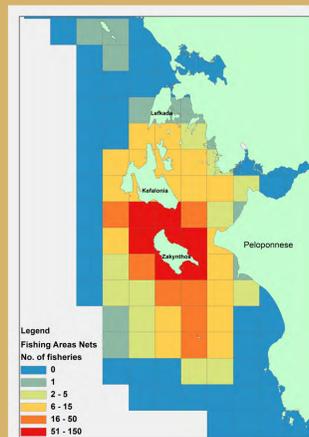


Figure 3. Fishing areas for nets

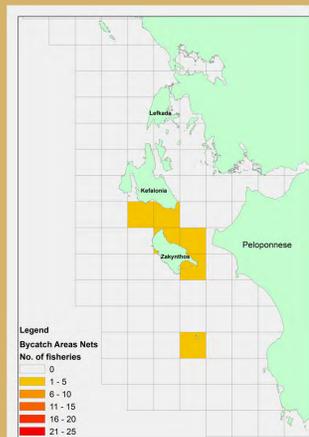


Figure 4. By-catch areas for nets

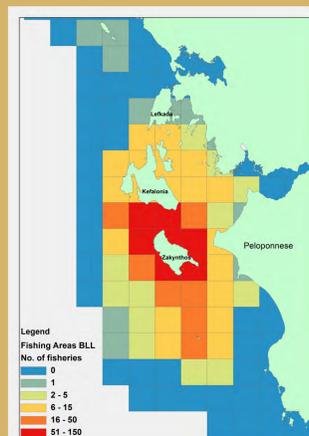


Figure 5. Fishing areas for bottom longline

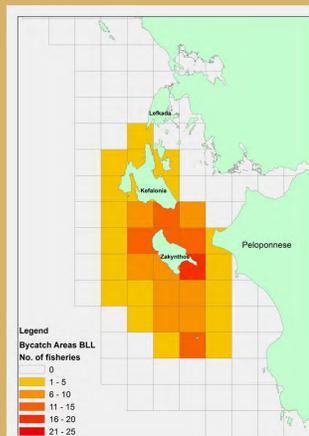


Figure 6. By-catch areas for bottom longline

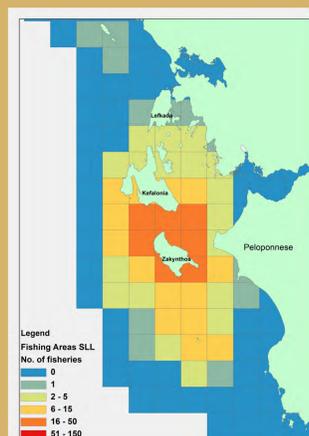


Figure 7. Fishing areas for surface longline

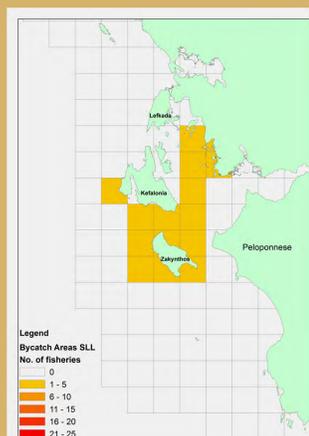


Figure 8. By-catch areas for surface longline

Table 1. Estimated fishing effort

Season	Nets [m]	No. fisheries	Bottom longlines [hooks]	No. fisheries	Surface longlines [hooks]	No. fisheries
Spring	7,552,441	137	1,462,196	124	196,368	38
Summer	6,985,941	135	1,597,282	124	225,875	40
Autumn	8,264,297	135	1,421,276	105	110,380	30
Winter	8,618,218	117	1,421,276	70	69,425	8
Annually	31,420,897	139	5,902,030	133	602,048	48

Table 2. Estimated annual by-catch rates without considering seasonal variation of fishing effort and by-catch rates

Species	Nets [ind/1000m]	Total [inds.]	B.L. [ind/1000hooks]	Total [inds.]	S.L. [ind/1000hooks]	Total [inds.]
Larus audouinii	0	0	0	0	0	0
Phalacrocorax aristotelis	0.00003	1	0.00071	4	0	0
Coloenebris diomedea	0	0	0.0626	351	0.06976	42
Puffinus yelkouan	0	0	0	0	0	0

Table 3. Average by-catch per species per km of nets per season

Species	Total [inds.]	Annual	Spring	Summer	Autumn	Winter
Larus audouinii	0	0	0	0	0	0
Phalacrocorax aristotelis	1	0.00001	0.00003	0.00003	0	0
Coloenebris diomedea	0	0	0	0	0	0
Puffinus yelkouan	0	0	0	0	0	0

Table 4. Average by-catch per species per 1,000 bottom longline hooks per season

Species	Total [inds.]	Annual	Spring	Summer	Autumn	Winter
Larus audouinii	0	0	0	0	0	0
Phalacrocorax aristotelis	4	0.00091	0.00017	0.0042	0	0
Coloenebris diomedea	351	0.05749	0.06175	0.15307	0.00405	0.00078
Puffinus yelkouan	0	0	0	0	0	0

Table 5. Average by-catch per species per 1,000 surface longline hooks per season

Species	Total [inds.]	Annual	Spring	Summer	Autumn	Winter
Larus audouinii	0	0	0	0	0	0
Phalacrocorax aristotelis	0	0	0	0	0	0
Coloenebris diomedea	42	0.04163	0.03655	0.375	0	0
Puffinus yelkouan	0	0	0	0	0	0

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